DEPARTMENT OF AGRICULTURE AND TECHNICAL INSTRUCTION FOR IRELAND.

REPORT

ON THE

SEA AND INLAND FISHERIES OF IRELAND

FOR

1906.

IN TWO PARTS.

PART I.—GENERAL REPORT.

PART II.—SCIENTIFIC INVESTIGATIONS.

PART II.—SCIENTIFIC INVESTIGATIONS.

Presented to both Houses of Parliament by Command of His Majesty.

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To

His Excellency JOHN CAMPBELL, EARL OF ABERDEEN, Lord Lieutenant-General and General Governor of Ireland.

MAY IT PLEASE YOUR EXCELLENCY,

I am directed by the Vice-President to submit to Your Excellency the Report on the Sea and Inland Fisheries of Ireland for the year 1906, Part II., Scientific Investigations.

I have the honour to remain,

Your Excellency's faithful Servant,

T. P. GILL

Secretary.

DEPARTMENT OF AGRICULTURE AND
TECHNICAL INSTRUCTION FOR IRELAND,
UPPER MERRION-STREET,
DUBLIN, *8th April*, 1909.

DUBLIN CASTLE,
13th April, 1909.

SIR,

I have to acknowledge the receipt of your letter of the 8th instant, forwarding, for submission to His Excellency the Lord Lieutenant, the Report on the Sea and Inland Fisheries of Ireland for 1906, Part II., Scientific Investigations.

I am,

Sir,

Your obedient Servant,

J. B. DOUGHERTY.

The Secretary,
Department of Agriculture and
Technical Instruction for Ireland.

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To the

Secretary of the Department of Agriculture and Technical Instruction for Ireland.

Department of Agriculture and Technical Instruction for Ireland,
Fisheries Branch.

SIR,

I have the honour to submit the following Report, prepared by Mr. E. W. L. Holt, Scientific Adviser to the Fisheries Branch of the Department, and forming Part II. of the Report on Sea and Inland Fisheries of Ireland, 1906, *already submitted.*

I have the honour to be,

Sir,

Your obedient servant,

Wm. Spotswood Green,

Chief Inspector of Fisheries.

15*th March*, 1909.

SEA AND INLAND FISHERIES, 1906.

REPORT OF THE SCIENTIFIC ADVISER.

To the Chief Inspector of Fisheries.

Sir,

I have the honour to submit my report on the scientific work of the Fisheries Branch for the year 1906. The association of the report with a definite period of twelve months is necessarily somewhat illusory, since the delays incidental to the preparation and printing of the technical memoirs which form the Appendix not infrequently carry the date at which it becomes possible to write the covering précis somewhat far into the succeeding year, and it appears to be desirable to note anything of special interest which may occur previous to such date.

SEA FISHERIES.

International Investigations.—The second period for which the expenditure necessary for the British share of these investigations was sanctioned by H. M. Government terminated in July, 1907, but has been extended for a further period of twelve months, pending the findings of a Committee appointed to consider this and other matters relating to fisheries research. The quarterly observations associated with the international scheme have been duly carried out by my colleagues, Messrs. Farran and Kemp, and the hydrographical results have been communicated to and published by the International Bureau. In the hydrographical section are included not only physical data, as of temperature and salinity of the waters, but also tabulation of those organisms, technically summarised as Plankton, which, presumably incapable of sustained movement other than in the direction taken by the medium in which they have their being, are held to afford by their annual and seasonal distribution evidence of the migrations of the waters. When we consider that our most valuable sea-fisheries are those of mackerel and herring, and that these fishes are, in so far as relates to the opportunity of their capture, creatures of the upper waters rather than of the bottom, the necessity of a proper study of the movements and changes of the surface and middle waters becomes at once apparent, since it can hardly be doubted that the distribution of these fishes responds in some degree to the distribution of water of salinity and temperature congenial or otherwise to their mode of life. Moreover almost all our market fishes,

though many are only to be taken in marketable condition on the bottom, pass more or less of their early life in the upper strata of the sea, and must go whither the current takes them. The ebb and flow of the tide along our coasts, and its response to local conditions of wind force, are familiar enough and fishermen are accustomed to direct their operations in a reasonably full knowledge of the effects of both tide and wind upon the fishes which according to the season may be engaging their attention. The great annual ocean tide is, however, a discovery of comparatively recent years and all that we know about it is that it does in fact occur every year, but is immensely variable in degree. Unlike the daily tides it is not a matter of obvious elevation or lowering of the coastal water level, but an interchange of waters of different saltness and different temperature, the practical result being that the belt of comparatively non-saline water which laves our western coasts in summer is reduced in width in winter to a greater or less degree by the invasion of salter water from the more central parts of the Atlantic. That most fishes are intolerant of considerable changes in the salinity of water is known to everyone. That some at least of our most valuable kinds are sensitive to comparatively small differences of salinity appears, from such additions as are from time to time being made to knowledge, to be at least probable; and if such sensitiveness can be proved we shall easily understand the effect on fishing operations of the width of the belt of water of the required composition. Supposing, for the sake of illustration (very likely it may prove to be untrue), we say that mackerel prefer water of less than 35 ‰ salinity. In winter and spring the isohaline of that salinity may hypothetically come within 10 miles of the coast or may not get nearer to it than 70 miles. Taking the number of fish as a constant (which no doubt it is not) mackerel will obviously be more thickly placed in a belt of 10 miles than in a belt of 70 miles, though their congregation within the belt of whatever width may be locally determined by other factors, such as the movement of the food-organisms which they pursue at the season in question.

Still using the mackerel as the theme of an argument, which is merely illustrative and does not pretend to be based on adequately proved facts, it is necessary to ascertain whether the creatures which it eats have themselves any predilection for water of a particular composition, and if so, how far it is the walling in of the food supply, and not the mackerel's own taste in the matter of salt and temperature, that brings the fish into the strata of water suitable for the operations of drift-net, seine and hand-line; or, to anticipate a westward extension of an apparently profitable fishery, the trawl.

As you are aware, the perfecting of knowledge on these matters is but a means to an end, for it will profit us nothing to know that certain physical and biological conditions are favourable to a successful fishery, unless we acquire some

means of predicting when and where these conditions are likely to occur.

At present a mackerel boat, whether smack or seine-boat, fits out at a certain date, probably determined by recollection of the fortunes of the few preceding seasons, and fishes nightly until fish are got in quantity or, in the absence of such a consummation after a reasonable period of trial, until the crew get tired of unremunerative sea-dangering. If the biologist's theories are right he will be able to demonstrate that the waters are suitable for catching fish at precisely the same time as the fisherman catches them, and the most that he can do in this way is to save the wear and tear of nets involved by nightly fishing before the fish rise.

What we have to do is therefore to find out what are the causes which determine the extent of the annual salt-water tide, and then from observations of the data which may prove to be of importance to endeavour to forecast the result in time to be of some use for the guidance of fishermen in fitting out for a particular campaign. It is almost certain that the necessary observations are not in themselves difficult if the field of work can be sufficiently extended; it is quite certain that the period of study must embrace many years, so as to eliminate errors caused by what one may term the chance irruption of factors which are not normally operative. Possibly, as I understand is the case in regard to some cereal crops, the data of one year may prove to afford means of estimating the conditions of the next; possibly the necessary period of observation may be longer or, *per contra*, almost immediately antecedent data may prove to be essential. So far I have assumed that when the water conditions are suitable, the fish will be found in unvarying number, but such an assumption neglects the fact that fish take some five years to come to marketable condition and may live for an indefinitely longer period. It follows, therefore, that in forming an opinion on the prospects of a particular season it is necessary to consider the probable effects of at least four preceding seasons on the stock, while the question is further complicated by the apparent fact that certain fishes, though very widely distributed, only achieve success as breeders in particular regions. In such cases fish which form an important feature in our statistics may be derived from breeding grounds far outside our area and may, in addition, have annually flowed and ebbed through a region wider than our individual sphere of observation.

I have written upon these matters at perhaps undue length because the objects sought to be attained by the study of hydrographical conditions and of the life-histories of fishes (and other organisms), which we cannot possibly hope to control, do not appear to be universally understood.

Trawling.—The survey of the deep-sea grounds off the south-west coast has been brought to a conclusion, so far as regular quarterly trawling is concerned, but the cruiser will still make occasional hauls in that region for the purpose of clearing up points that may arise while we are working out

the material. Allowing for the short time disposable for deep-sea work and the frequent interruptions due to weather, a very fair knowledge of the nature of the ground and of its products at different seasons has been acquired, and is in process of tabulation. I hope to be able to print a full account of the takes of fish in each haul in the course of next year, while the other items of the catch are dealt with by my colleagues.

The survey of trawling grounds in the Irish Sea has been regularly prosecuted, and at the end of the present year it is proposed to collate and publish the results. Mr. Farran is preparing a report on the flat-fish marking experiments, which will be of the greatest importance in interpreting the lists of hauls.

It is probable that the conclusion of the west coast deep-water survey will enable us in the future to deal in greater detail with the inshore trawl-fisheries of the southern and western littoral. The south coast, especially, presents some problems for the elucidation of which we require a good deal more evidence than is at present available.

It is matter of regret that we have been unable to test the possibilities of long-lining and drift-netting in this region, but, as you know, these methods of fishing do not lend themselves to combination with others, and, moreover, for their safe and effective prosecution from a big vessel like the *Helga*, require a larger crew than she carries. Probably, as our various schemes of work mature, time will be found in the future for deep-sea cruises devoted chiefly to lines and drift-nets. Of the possibilities of the latter for market purposes I am not sanguine, for on reasonably calm nights Messrs. Farran and Kemp have always studied the surface fauna with the aid of an electric cluster lamp and have seen and caught many creatures of scientific interest, but, excepting squid, nothing of market value. Squid command a high price as bait in England and Scotland, and the case with which they may be caught on occasion from the ship's side would be of importance to deep-sea line-fishermen. On their last cruise my colleagues were able to trace to the agency of squid (the species is *Ommastrephes sagittatus*) certain noises and disturbances of the surface which they would otherwise have attributed to fish. Quite probably surface phenomena of the same nature may have from time to time have been regarded by observers on Atlantic liners as indications of the presence of marketable fish. If mackerel or herring do in fact occur at the surface at great distances from the western and south-western coast, it is at least remarkable that they have always contrived to elude the notice of the *Helga*, which for several years has regularly worked this region at all seasons as far as seventy miles seawards. Inshore, on the usual fishing grounds, these fishes are quite commonly seen while the ship is running her courses out and in, and their escape from observation over deep water is probably more than a matter of chance.

Mackerel and Herring Fisheries.—On this subject I have little to add to the remarks which I have made above in reference to the International Investigations. The Department was invited by the English Board of Agriculture and Fisheries to co-operate with the Lancashire and Western Sea Fisheries' Committee in a scheme of investigation proposed to be undertaken by the Committee in regard to the movements of herring in the St. George's Channel and Irish Sea, and correspondence passed between Professor Herdman and myself on this subject. The particular object of the proposed research, *viz.*, the locating of shoals such as in former years appear to have afforded a summer and early autumn fishery to Manx boats, was not of primary importance to our fleets, which are now more or less profitably engaged at various places during the period in question; though, of course, any addition to our knowledge of the movement of herring would be useful, and we would not willingly let slip any opportunity of assisting our neighbours. You yourself, however, were acquainted with serious attempts made many years ago to pursue the fish from the south-east coast of Ireland up Channel and of their failure in most competent hands. The *raison d'être* of the proposed research rested on the assumption of an up-Channel migration, of which the available size-statistics of herring from different grounds give no clear proof, though occasional irruptions of the species into narrow waters show that there may be always near our coasts herring of a smaller size than the drift-nets can, or at any rate do, capture. Considering the possibilities of a really efficient hunt for herring over a wide area, I was compelled to the conclusion that it would be necessary to fit out at least two steam-drifters to quarter the ground properly, and to a scheme of such magnitude we were precluded from contributing by financial reasons. We were, therefore, obliged to decline to co-operate in a scheme of investigation involving the endeavour to capture the fish by experimental drift-netting, but out of our negotiations on this subject we have evolved with our English colleagues a joint scheme of hydrographic research in the Irish Sea and St. George's Channel. At the latitude of the Calf of Man the *Helga* and the Lancashire vessel effect a complete sectional survey of the Irish Sea on the same day, thence, turning southwards, the two ships run lines of observing stations down the Channel, and from the Tuskar the *Helga* runs a course so as to meet the Marine Biological Association's steamer coming up from the Land's End. Combined action of this sort is much easier in theory than it has proved to be in practice, because the weather often prevents exactly simultaneous observations. I think, however, that we have made a distinct advance towards a perfect system of co-ordination of work.

The prospect of a profitable study of the herring problem has been greatly improved by Dr. Hjort's discovery of a method of determining the birth-period and the age of the fish by the examination of their scales. As everyone knows herring, unlike most market fishes, are not restricted to any

one period of the year for spawning, but their breeding seasons can be roughly divided into summer and winter. The possibility of distinguishing summer-bred from winter-bred fish seems likely to immensely facilitate the elucidation of the history of the shoals which form the objects of the various fisheries. So far as Ireland is concerned, the Ulster Fisheries and Biology Association, which receives a subsidy from the Department in consideration of carrying out research under our direction, has undertaken an investigation based upon Hjort's methods.

Oyster Fisheries.—I hoped to have been able to include in the Appendix to this report an account of the results of our experiments in oyster culture, in continuation of the paper presented by Mr. Hillas and myself in 1905; but Mr. Tattersall and Mr. Hillas, who have undertaken its preparation, have not been able to complete it in time, owing to the labour involved in making out the statistical tables which are absolutely essential to the proper statement of fact. I may say, however, that as regards our attempt to secure semi-artificial reproduction in the pond at Ardfry, the season of 1906 yielded a considerable but very late fall of spat, which so far has done very well. The 1907 fall, in spite of apparently adverse conditions of weather, has been one of the best which we have had, and consideration of the circumstances to which it is apparently due has suggested experiment in a more completely closed nursery. One of the greatest difficulties which we encounter is the proper drying of the collecting tiles after they have been coated with mortar. Our Continental neighbours can apparently depend upon being able to dry the mortar in the open, but we certainly cannot during the period which, having regard to other pre-occupations incidental to the management of an oyster fishery, would be available for the preparation of the collecting apparatus. We could, of course, put up efficient drying sheds, but I see no advantage in doing so, because it would involve, in my opinion, over-capitalisation of the enterprise. So far we have got no good out of birch twigs, which are the collectors used in Norway, but it is possible that alteration in their disposition, suggested by recent experience, may give better results. Though tiles, when the coating is satisfactorily dried, do well enough, their present cost is prohibitive for the purposes of a practical fishery, for after exhaustive inquiry I found it was much cheaper to import them from Brittany than to buy them from any manufactory in Ireland. The expense and risk of carriage over so great a distance does not appear to be a fair addition to the price of an article not obviously costly in the making.

The policy of assisting the natural recuperation of the Clarenbridge public oyster fishery has been continued, and in the spring of 1907 we laid down on the outer and most thinly stocked part of the ground some 156,000 Brittany seed oysters. In my last report I mentioned that in 1906 we laid

seed derived from ground layings, since it was represented to us that, though somewhat more expensive, it was considerably more valuable than the smaller stock derived from caisses. It certainly appeared to be so on importation, but we obtained, for observation at Ardfry, seed of both qualities. A year's observation of the two suggested that for our purposes the cheap stock was at least as good as the other, and for the 1907 laying we were content to import caisse seed. Owing to unfavourable conditions in the preceding season our importation, though fully up to specification, was of a quality much inferior in size to that of the two previous years, but the sample which we have kept under observation at Ardfry seems to have grown well enough.

One result of our stocking operations at Clarenbridge was a revival of general interest in the fishery, which had suffered a slight and, in its interests, welcome neglect during the recent years of its decadence. In consequence the annual fishery of 1906, confined by local arrangement to the first fortnight in December, was prosecuted by an unusually large number of dredgers, with the result that although the aggregate catch, computed at 245,000, was satisfactory, the shares of the regular fishermen were not so much enhanced as to produce a greatly augmented return in cash. The local market was bad, and the considerable proportion, in the catches, of flat-shelled French oysters, the survivors of our first layings, reduced the current price. The dredgers are quite able to appreciate the fact that 300 oysters at, say, 4*s*. per hundred are better than 200 at 5*s*. per hundred, and entirely approve of the Department's action, while cognisant of the fact that we lay the stock not to augment their catches by the capture of more or fewer of the actual French oysters, but to increase spatting by the reproduction of these oysters before they reach the legal standard. Some at least of the buyers consider that the present size limit, 2¾ inches, is too low, but I do not think it is yet practicable to raise it. As the bed regains its former productivity, as I have no doubt it will under the present efficient system of protection, it is probable that the raising of the size-limit will commend itself to regular dredgers. Our chief difficulty is that no oyster bed will stand the demands of all comers, and that there is at present no means of restricting the number of boats to the reasonable possibilities of a profitable return.

I imagine that the actual fisherman lands oysters of a value very considerably in excess of the price which he gets for them, but the problem of placing him in direct communication with the consumer or even with the town fishmonger is one of great difficulty in all cases, and especially with such a fishery as that of Clarenbridge, which lasts only for a fortnight. So far as I know anything of trade conditions, it is only the man who throughout the season can produce as many oysters as may be required, who is able to maintain a business independent of the local middleman. This fact, if such it be, lies very near the factor determining the commercial success of private as well as public fisheries.

As I mentioned in my last report, the Department was asked, on behalf of the fishermen interested, to take over the public beds of Clew Bay with a view to restoring them to a condition of productivity. The Department were willing to do so, and the devising of a self-supporting scheme of expenditure presented no difficulty, but we were advised by the Law Officers that it was impossible to grant a licence to the Department and there was consequently no means of securing effective control over the beds other than that which you can at present exercise by by-law.

The local conditions are very different from those of Clarenbridge but the only course open to us was to attempt the same means of improvement on a limited area which could be effectively protected at reasonable cost. The local fisherman whom we appointed as bailiff appears to have taken a liberal view of his responsibilities and has in fact kept the area on which we laid the young stock in 1906 and 1907 free from the incursion of dredgers, while he has also been active in checking the small trading craft which frequent the Inislyre Roads from infringing the by-law relative to the discharge of rubbish on the beds. I am afraid, from such observation as has been made of the growth of the laid stock, that the Clew Bay beds possess a power of natural recuperation much inferior to that of Clarenbridge. The number laid in 1907 was 120,000.

The Tralee beds, now the most important source of supply of Irish natives, appear to be in excellent condition, and in closing these remarks I should like to pay a tribute to the services of our principal oyster bailiff, Mr. Lannon, to whose vigilance and tact the present satisfactory conditions of the Tralee and Clarenbridge beds is chiefly due.

Mussel and Periwinkle Fisheries.—Considerable success appears from the reports of the Lancashire and Western Sea Fisheries Committee to have attended the transplantation, on a practical scale, of mussels in that district. In the theory of the operations there is nothing new, but their practical application by a *commune* of fishermen is a distinct advance as far as concerns the United Kingdom. In this country we have so far been less successful, although for the sake of the object lesson we have offered, in the case of a certain public fishery, to pay very generously for services rendered in a first transplantation of stock from the sloblands, where mussels never grow large, to deep-water beds now more or less depleted. From circumstances brought to our knowledge in the case of oyster as well as mussel fisheries, reluctance to assist in transplantation work appears to arise from two causes. Firstly, the individual fishermen are unwilling to lend a hand to any operation that may benefit casual invaders of the fishery as much as themselves, and, secondly, there still lingers, but only in some places, a deep-rooted distrust of the motives which induce us to try and improve a fishery. In time we shall perhaps live down this distrust in one place as well as another, but meanwhile it is rather a serious obstacle in the way of fishery improvement.

For an illustration, in case such were needed, of the possibility of transforming slob mussels into marketable stock, we have conducted transplanting experiments at Ardfry with satisfactory results. Independently, Mr. King, who has a licence for a mussel bed in the estuary of the Nanny in County Louth, has been most successful in transplanting stock, and has demonstrated that not only are the spat taken from places far above the line of good growth capable of rapid increase at the right level, but also that the old thick-shelled stock from similar situations is capable of the full measure of growth when transferred to low water mark.

With regard to periwinkles, which, as your report shows, make a very substantial contribution to the total value of Irish sea fisheries, I was led to suppose, by observations made incidentally in connection with our oyster experiments at Ballynakill, Muckinish and Ardfry, that something might be done to facilitate the gathering of large, while leaving unmolested small periwinkles, by the simple method of driving in wooden pickets over the grounds frequented by the mollusc in question. We accordingly made an experiment on these lines at Ardfry, but the results, as Mr. Tattersall's report will show in due course, have been unsatisfactory, and the proper method of periwinkle culture is still to seek. Mr. Tattersall has, however, been able to make most interesting observations upon the breeding of periwinkles, which was a matter of some obscurity.

INLAND FISHERIES.

The part of the Appendix relating to this subject contains nothing which requires special comment. The output of hatcheries, though less than that of the preceding season, is still in excess of any other, and as public interest in this work is continually increasing we may reasonably hope, while making allowance for years in which the capture of breeding stock presents unusual difficulty, to maintain a general average increase.

Our salmon-marking experiments have been continued on the usual scale, and we are indebted to Mr. Hillas for the devising of a marking apparatus which seems likely to enable us to successfully label smolts as well as larger fish. It consists of a pair of forceps something after the fashion of the implement used for the affixing of a ring in the nose of a pig, but naturally much smaller. One pinch of the forceps fixes in the fish a ring which carries a small tag inscribed with a letter and number, and the necessary handling of the fish is consequently reduced to a minimum. We have already been able to demonstrate by means of this apparatus that the "pink" of certain Kerry rivers are actually young White Trout. In the coming season it is hoped that we may be able to mark a number of salmon smolts in a manner which, while occasioning no undue inconvenience to themselves, will absolutely

demonstrate the history of the fish which may be again caught as peal, while we intend to use the same apparatus, in larger size, for the marking of adult salmon and of sea fishes.

The report relative to the periods of ascent of eel-fry in different rivers is the first of its series. As the subject is of considerable importance, having regard to possible developments in the eel fishery, effort will be made to secure more complete information in future years.

SCIENTIFIC PAPERS.

The reports which form the Appendix are mainly of a technical character. Perhaps the most important of them is Mr. C. Green's index to our scientific publications of the last five years, which, if not a report in the ordinary sense of the word, is nevertheless a contribution of great utility to ourselves as well as to colleagues who in all parts of the world appear to find our papers worth reading.

Mr. Farran has worked out our gatherings of the pelagic organisms known collectively as Salps, oceanic creatures which, though of no great importance as fish food, afford by their occasional invasions of our littoral an indication of the accidence of ocean currents. On behalf of the Ulster Fisheries and Biology Association Messrs. Buchanan-Wollaston and Gough contribute respectively papers on the sedentary tunicates and bottom deposits of the Larne region. With the assistance of Mr. Byrne I present a second report on the fishes of the deep-water section of our fishing grounds, containing descriptions and illustrations of some of the as yet unfamiliar fishes which have been found to be inhabitants of that region.

Mr. Farran in another paper deals with his recent observations of the copepoda, a group of minute crustaceans the importance of which requires, in this year of grace, no explanation.

In conclusion I desire to express my acknowledgements to my colleagues, the Assistant Naturalists, and to the Technical Assistant, for help in the preparation of this report as well as for the prosecution of the researches with which it deals.

I am,

Sir,

Your obedient Servant,

E. W. L. HOLT,

Scientific Adviser.

22nd October, 1907.

APPENDIX

TO

REPORT

ON THE

SEA AND INLAND FISHERIES OF IRELAND

FOR THE YEAR 1906.

PART II.—SCIENTIFIC INVESTIGATIONS.

APPENDIX, No. I.

ON THE DISTRIBUTION OF THE THALIACEA AND *PYROSOMA* IN IRISH WATERS.

BY

G. P. FARRAN, B.A.

The following notes deal with the distribution of the species of Doliolum, Salpa, and Pyrosoma observed on the W. and S.W. coasts of Ireland during 1901-1906. There is still a good deal of townet material unsorted, which will probably add somewhat to the list of records, but enough has been dealt with to give the main features of the distribution during the period in question, and it seems advisable to put the results on record.

The species met with were :—

Doliolum tritonis, Herdman.
Doliolum, sp. (probably identical with the species described under this name by Borgert (1894, pp. 17-18).
Salpa mucronata, Forsk.
S. confoederata, Forsk.
S. fusiformis, Cuv.
S. asymmetrica, Fowler.
S. zonaria, Pallas.
Pyrosoma spinosum, Herdman.

Two of these, viz., *Salpa confoedcrata* and *Pyrosoma spinosum*, have been considered, and doubtless are, distinctly southern forms whose occurrence in our. area must be attributed to an exceptional northward extension of their range, to whatever cause it may be due. The remaining six species have already been recorded from the N.E. Atlantic in the same or higher latitudes.

In the synonomy given with each species I have merely quoted such authorities as give good or accessible figures of the animal.

Doliolum tritonis, Herdman.

Doliolum denticulatum, Herdman, 1883, p. 101, Pls. 18-20.
Doliolum tritonis, Herdman, 1888, p. 47, Pl. 3, fig. 3.
Doliolum tritonis, Borgert, 1894, p. 19, Pl. 5, figs. 17-18.
Doliolum tritonis, Borgert, 1901, p. 3, fig. 3.
Doliolum tritonis, Ritter, 1905, p. 85, figs. 24-26.

Fisheries, Ireland, Sci. Invest., 1906, *I*, [*Published, December*, 1906].

B

The gonozooid or sexual form of this species is from May to November apparently widely distributed in small numbers all along the west coast of Ireland at thirty or more miles from shore; or more probably its shoreward limit is marked by the surface isohaline of 35·30 S°/oo, though it is occasionally found in small numbers quite close to land. Outside this line it occurs at times in immense shoals such as those met with by the *Helga* on the Porcupine Bank in June, 1901, 77 miles off Achill Head in August, 1901, and 50 miles N. by W. of Eagle I., Co. Mayo, in August, 1904, and it seems not improbable that most of the inshore records are referable to stragglers from such shoals which happened to be lying off the coast. The shoal of June, 1901, of which that of August, 1901, may have been an outlier, was composed almost entirely of very large gonozooids in perfect condition, no blastozooids having been noticed on that occasion.

It is of interest to enquire into the ultimate destination of these shoals. It seems not unlikely that they pass slowly northwards, either striking the N.W. coast of Scotland or meeting extinction in the colder waters N. of the Färöe Channel.

The species was first described from specimens brought home by the *Triton*, which met with immense shoals between the Hebrides and Färöe Islands (Herdman, 1883). The Plankton Expedition (Borgert, 1894), though finding it in greatest abundance in the warmer parts of the Atlantic, particularly between Cape Verde Islands and Ascension and in the western part of the Gulf Stream, between Newfoundland and the Bermudas, also captured numerous specimens north of the Hebrides and for 200 miles to the westward on the line from the north of Scotland to Cape Farewell in Greenland, though beyond that distance none were found. Dr. G. H. Fowler (1898, p. 581) met with similar shoals in the Färöe Channel in 1896, and in 1897 (ibid., p. 582) he records the species as present in abundance at 400-500 fathoms, though scarce at the surface, suggesting that this is a case in which a shoal, having been killed by the unfavourable conditions it has encountered, is gradually sinking. Any conjectures, however, as to the later history of these shoals must be rendered doubtful by our ignorance of the length of life of any of the stages of Doliolum.

The blastozooid or oozoid generation, presumably belonging to *D. tritonis*, was usually met with singly or in very small numbers in the degenerate broad-banded stage. It usually measured from 10 to 12 mm. in length, but occasionally was much larger, the largest example noted reaching 2·5 cm. The only occasion on which anything like a swarm of this form was noticed was on 9th August, 1904, 50 miles W.N.W. of Cleggan, where it occurred in moderate numbers at 30, 60, and 110 fathoms unaccompanied by the gonozooid which was represented by several very small specimens at the surface.

The undegenerate blastozooid was only met with twice, viz., 31st July, 1901, 10 miles N. of Cleggan, 30 fathoms,

when four specimens were taken, and 20th May, 1905, 50 mi. N. by W. of Eagle I., Mesoplankton trawl, 1,150 fathoms, one specimen (this last-mentioned net was fished open to the surface, so the depth given does not necessarily represent the depth at which the specimen was taken). These specimens measured from 1·0 to 1·5 mm., and were each enclosed in a gelatinous envelope resembling the house of Oikopleura, but fitting closely to the zooid. They were not in good condition, and the branchial slits could not be made out. In other respects they agreed closely with the figure of this form given by Dr. G. H. Fowler (1905, Pl. VIII., fig. 1). In each case they were accompanied by a considerable number of very small (3-4 mm.) specimens of the gonozooid.

At the first-mentioned station one specimen of the blastozooid, 2·3 mm. in length, shewed traces of commencing degeneration. The muscle bands had thickened, and were about equal to the intervening spaces. It bore a small dorsal stolon with buds attached. The stomach and gut were still present.

In the list of specimens which follows the diagnostic points relied on were the relation of the endostyle and dorsal ganglion to the rings, the position of the testis and the curve of the gut. It is difficult, except in well-preserved specimens, to make out definitely the line of the branchial slits, but as *D. tritonis* may be separated from all described species except *D. Gegenbauri* without reference to this character, and as the latter species is confined to the Mediterranean and, according to Borgert, (1894, p. 20) of doubtful value, this omission to verify the position of the slits may be excused.

The mark of interrogation which follows some of the records given below indicates that the identification though probable is not absolutely certain, in most cases owing to the injury or bad preservation of the specimen.

Date.	Station No.	Locality.	Depth of Net. Fms.	Gonozooid.	Blastozooid.
1901. 18/6	Helga LXXIII.	40 mi. N.W. by N. of Cleggan Head, Co. Galway.	0	1 large, 4 small.	
			105	36 large, 10 medium.	
28/6	Helga LXXIV.	36 mi. N.W. by N. of Cleggan Head.	44	? 4 small.	
			88	? 8 small.	
29/6	Helga LXXVII.	53° 24′ 30″ N. 13° 36′ W. (Porcupine Bank.)	41	Enormously abundant.	
			91	Not quite so abundant.	
29/6	Helga LXXVIII.	53° 23′ N. 13° 13′ W. ...	0-120	Many.	
29/6	Helga LXXIX.	53° 23′ N. 12° 43′ W. ...	0	Enormously abundant.	
			85	Abundant.	
			175	Few.	
2/7	Helga LXXXI.	10 mi. N.W. by N. of Cleggan Head.	26	? 4 small.	
5/7	Helga LXXXV.	40 mi. N. of Cleggan Head.	43	*ca* 150 large and medium.	
			80	*ca* 40 large.	
8/7	Helga LXXXVIII.	40 mi. W.N.W. of Cleggan Head.	76	? 2 very small.	

Date.	Station No.	Locality.	Depth of Net. Fms.	Gonozooid.	Blastozooid.
1901.					
31/7	LVII. ML.	3½ mi. W.S.W. of Shark Head, Co. Galway.	0	—	1.
31/7	Helga CVI.	10 mi. W.N.W. of Cleggan Head.	55	? 1 very small.	
31/7	Helga CVII.	10 mi. N.W. by N. of Cleggan Head.	0 26 50	20 small. 18 small. ... ? 10 small.	 1.
31/7	Helga CVIII.	10 mi. N. of Cleggan Head,	20 40	ca 400 small & very small. ca 60 very small,	4 small. 1.
1/8	Helga CXI.	Inside Clare I., Co. Galway,	10	? 1 very small.	
2/8	Helga CXII.	20 mi. S.W. of Cleggan Head,	0	? 2 very small.	
23/8	Helga CXVIII.	23 mi. N.W. by W. ½ W. of Cleggan Head.	0 72	2 small. —	 3 small.
24/8	Helga CXX.	77 mi. W.N.W. of Achill Head, Co. Mayo.	0 190 0–380	ca 66. Very numerous. Very many.	
24/8	Helga CXXI.	64 mi. N.W. ½ W. of Cleggan Head.	0–199	ca 180 large, ...	ca 35 large.
12/9	Helga CXXXI.	50 mi. W.N.W. of Cleggan Head.	0 100	2 large. 25 large.	
13/9	Helga CXXXII.	50 mi. N W. by N. of Cleggan Head.	60 120	2 large. 2.	
1903.					
14/2	S.R. 5	50 mi. W.N.W. of Tearaght, Co. Kerry.	50 100	? 1. ? 4 small.	
2/5	S.R. 15	50 mi. W.N.W. of Tearaght,	15 43 120	ca 50 very small Few very small. 3 medium.	
8/5	S.R. 16	50 mi. W.N.W. of Tearaght,	0 50 75 100	250 small. 2 small. ca 40 very small ca 30 small.	
8/5	S.R. 20	30 mi. W.N.W. of Tearaght,	50	12 medium and small.	
7/8	S.R. 31	50 mi. W.N.W. of Tearaght,	29 93 129	603. 35 large. 40 large.	
13/8	S.R. 39	50 mi. N.N.W. of Rathlin O'Beirne, Co. Donegal.	0 95	2 large. 5 large.	
13/8	S.R. 41	30 mi. N.N.W. of Rathlin O'Beirne.	30	1 large.	
17/8	S.R. 46	30 mi. W.N.W. of Cleggan Head.	0 40	1 large. 2 large.	
19/8	S.R. 49	50 mi. W.N.W. of Tearaght,	90	20 medium.	
1904.					
4/8	S.R. 125	70 mi. S.W. of Fastnet, Co. Cork.	0 20 40 80	10 small. 5 medium. 3 medium. 0.	
4/8	S.R. 128	40 mi. S.W. of Fastnet, ...	0	—	1.
7/8	S.R. 132	50 mi. W.N.W. of Tearaght	60 160	? 2 small. ? 6 small.	
8/8	S.R. 133	30 mi. W.N.W. of Tearaght,	20 50	? 1 small. ? 4 small.	

Date.	Station No.	Locality.	Depth of Net Fms.	Gonozooid.	Blastozooid.
1904. 9/8	S.R. 135	50 mi. W.N.W. of Cleggan Head.	0	5 medium, 140 very small.	1–14 mm
			30	—	ca 60=10-15 mm.
			60	35, ...	10=10-15mm.
			110	—	23.
0/8	S.R. 136	30 mi. W.N.W. of Cleggan Head.	0	5 medium and small.	
11/8	S.R. 139	50 mi. N. by W. of Eagle I., Co. Mayo.	0	32 small.	
			116	378 large and medium.	
			275	500 medium and small.	
			400	430 large and medium, 300 very small.	
			800	1,280.	
			0-1,000	2,990.	
11/8	S.R. 140	40 mi. N. by W. of Eagle I.	0	6 large, 9 small.	
			350	450 small.	
			550	300 medium and large.	
24/8	S.R. 148	53° 27′ N. 13° 37′ W. (Porcupine Bank.)	0-735	Abundant.	
			0	5 small.	
			50	8 medium.	
			80	10 medium.	
27/8	S.R. 152	45 mi. N.W. by W. of Achill Head.	100	12 medium, ...	1=7 mm.
			220	50 medium, ...	1–9 mm.
14/11	S.R. 175	40 mi. N. by W. of Eagle I.	600	? 5 small.	
1905.					
11/2	S.R. 107	50 mi. N. by W. of Eagle I.	280	? 1.	
0/5	S.R. 212	50 mi. W. ¾ N. of Tearaght,	100	? 8.	
12/5	S.R. 224	53° 7′ N. 15° 6′ W. (Outside Porcupine Bank.)	750	Moderate. small,	Very few.
20/5	S.R. 230	30 mi. N. by W. of Eagle I.	50	? 2 small.	
20/5	S.R. 231	50 mi. N. by W. of Eagle I.	600	1 small.	
			0–1150	ca 50 small, ...	1 very small.
18/11	S.R. 282	50 mi. N. by W. of Eagle I.	0	? 7.	
			0-700	? 8, ...	6.

Doliolum, sp.

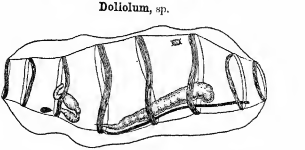

Fig. 1.

In 1894 Borgert gave a description of a Doliolum taken on ten occasions by the Plankton Expedition in the N. Atlantic in 450-850 fathoms, five of these captures being between the N. of Scotland and Greenland. He refrained from giving a

name to this form on the grounds that it might possibly be a variety of *D. Krohni*, with which it agreed in the position of the endostyle.

The same form was taken off the Bay of Biscay, 150-430 fathoms, by Dr. G. H. Fowler, who recorded it as *Doliolum, sp.*, Borgert (1905, p. 91), and admitted the possibility of its being a variety or pathological specimen of *D. Krohni*. Borgert (1901, p. 2) in *Nordisches Plankton* again recorded it as *Doliolum, sp.*

In May, 1904, a single specimen of a Doliolum, length 5 mm., was taken at 250 fathoms, 30 miles N. by W. of Eagle I., Co. Mayo, which in its main points agreed with the form mentioned above. The only difference of importance is in the testis, which is swollen throughout its length, and reaches forward almost to the 7th muscular ring, whereas the testis in Borgert's species is slender, and only reaches to between the 5th and 6th rings.

My figure (fig. 1), which is rendered somewhat diagrammatic by the omission of anything that seemed obscure, represents the actual form and relative position of the various organs in the specimen. The branchial slits were not well preserved, and could be made out with difficulty; they seemed to lie dorsally between the 3rd and 4th rings and ventrally between the 3rd and 5th. This differs slightly from their position in Borgert's species, but judging by the appearance of my specimen it is not unlikely that a general post-mortem shifting of all the parts had taken place.

It seems most probable that all the records refer to a single species distinct from *D. Krohni*, the longer testis in my specimen being perhaps a later stage of development, though in *D. tritonis* such an increase in length does not occur.

Date.	Station No.	Locality.	Depth of Net. Fms	—
1904. 11/5	S.R. 112.	30 mi. N. by W. of Eagle I., Co. Mayo.	250	One specimen (Gonozooid).

Salpa mucronata, Forsk.

Salpa spinosa, MacIntosh, 1868.
Salpa democratica-mucronata, Traustedt, 1885, Pl. II., figs. 25-28.
Salpa democratica-mucronata, Herdman, 1888, Pl. VIII., figs. 1-10.
Salpa mucronata, Apstein, 1884, pp. 32-33.
Salpa mucronata, Apstein, 1901, pp. 5-6, fig. 5.
Salpa democratica-mucronata, Ritter, 1905, p. 73, figs. 18-19.

Almost all the records of this species are referable to a large shoal which was met with off Cleggan, Co. Galway, in August, 1903. It stretched apparently from the shore to 22 miles off,

between which distance and 50 miles W.N.W. of Cleggan no specimens were found. A line of stations N.N.W. from Rathlin O'Beirne, Co. Donegal, shewed no trace of the species, which was only found in moderate numbers 10 miles from shore on the line running W.N.W. from Tearaght, Co. Kerry. The records of the Marine Laboratory at Ballynakill, Co. Galway, show that the shoal appeared rather suddenly in coastal waters about August 11th, remaining very abundant during August and moderately so during September. A few specimens were noted at intervals until November 17th, after which the species disappeared. The sudden appearance of the shoal seems to indicate that it must already have attained considerable size before striking the coast, against which it seems to have become banked up and crowded together. The swarm of *Lepas fascicularis* which occurred in the same locality about the same date (Farran, 1905, p. 209), showed in its later phase a very similar disposition. When observed on August 10th it lay between thirty and fifty miles from shore; but later, on August 17th, the barnacles were seen mainly between ten and twenty miles off, very few being noticed between twenty and fifty miles. The salp shoal seems to have been of limited size, and probably originated from a small body of either the sexual or asexual form which, passing slowly to the N.E. in the prevailing drift met with favourable conditions for reproduction or development in a coincidence of temperature, salinity and food supply. Once such a shoal was formed it would, as Fowler points out (1898, p. 581), while the conditions remained favourable, advance in a body of ever increasing numbers and density, there being no adequate cause why the zooids should become scattered one from another. There is nothing to show that sexual reproduction on any large scale took place in the coastal area, since developing embryos were only noticed in a very few instances, and the shoal consisted mainly of the sexual generation, the asexual generation forming less than 10 per cent. of the total, and being made up of specimens of large or medium size.

The occurrence of shoals of *Salpa mucronata* on the western coasts of the British Isles seems to be not unusual. Apstein, in his remarks on the swarming of Salps (1894, pp. 54-55), quotes several instances of such shoals from the Shetlands to the English Channel, and considers them to be a regular autumn feature of the Plankton in these regions. It seems, however, that as regards the west coast of Ireland the most that can be maintained is that the species can flourish in the less dense and somewhat colder coastal waters, but that the source from which such shoals are derived is in some other region, probably somewhere to the S.W. of the British Isles, the species not being, as far as our observations go, a permanent inhabitant, even in the smallest numbers, of our waters.

In the list of occurrences which follows, the Marine Laboratory records are not included, as they have been summarised above.

Miss Delap, in her summary of the plankton of Valencia Harbour for 1902-1905 (1906, p. 18, gives August—October, 1903, as the only occasion on which this species has occurred during the four years.

Date.	Station No.	Locality.	Depth of Net. Fms.	Sexual Form.	Asexual Form.
1903. 14/2	S.R. 5	50 mi. W.N.W. of Tearaght, Co. Kerry.	0	8 small, ...	—
4/8	S.R. 26	35 mi. S.W. of Fastnet, Co. Cork.	30	12 very small,	—
7/8	S.R. 33	11½ mi. N.W. by W. of Tearaght.	70 15	5, ... *ca* 50 medium,	1 large. *ca* 60 medium.
17/8	S.R. 47	20 mi. W.N.W. of Oleggan Head.	0	Ca. 3,100, ...	200.
17/8	S.R. 48	10 mi. W.N.W. of Cleggan Head.	30 58 0	1,200, ... 1,400, ... *ca* 1,000, ...	*ca* 300. *ca* 180. *ca* 150.
17/8	-	22 mi. W.N.W. of Oleggan Head.	25 55 0	*ca* 1,200, ... Very abundant, 3 (dipped up in bucket).	*ca* 190. Abundant. —
19/8	S.R. 53	8¼ mi. W.N.W. of Tearaght,	25	—	*ca* 80 medium and small.
1904. 1/11	S.R. 153	70 mi. S.W.½W. of Fastnet.	20 50	6. ...	2.

Salpa confoederata, Forsk.

Salpa scutigera-confoederata, Traustedt, 1885, Pl. II., figs. 23, 24, 46.
Salpa scutigera-confoederata, Traustedt, 1893, p. 13.
Salpa confoederata, Apstein, 1894, pp. 12, 33.
Salpa confoederata-scutigera, Ritter, 1905, p. 81, fig. 23.

The northern range of this species has been considerably increased by its capture by the *Helga* fifty miles off Tearaght, Co. Kerry. The previous most northerly record was one of a single specimen taken by the Plankton Expedition off Cape Finisterre in 47° 7′ N., 10° 4′ W. The true home of the species seems to be much farther south, the Plankton Expedition finding it in very large numbers on both sides of the equator between Ascension and the Cape Verde Islands (Apstein, 1894, p. 33). Several of the sexual generation taken by the *Helga* contained single developing embryos of about 4 mm. in length.

Date.	Station No.	Locality.	Depth of Net. Fms.	Sexual Form.	Asexual Form.
1905. 5/11	S.R. 272	50 mi. W. ¾ N. of Tearaght, Co. Kerry.	0 75	— 36 large and small.	Several very large. 3 large.

Salpa fusiformis, Cuv.

Salpa runcinata-fusiformis, Herdman, 1888, pp. 74-78, Pl. VI., figs. 5-12.
Salpa fusiformis, Apstein, 1894, pp. 14-15, 34.
Salpa fusiformis, Apstein, 1901, p. 7, fig. 6.
Salpa fusiformis-runcinata, Ritter, 1905, p. 64, figs. 12-16.

As far as the actual records go this species may claim to be the most widespread Salp occurring off the west coast of Ireland, though it is probable that in reality *S. asymmetrica* has a better right to that distinction. From May to September, *Salpa fusiformis* is generally to be found widely distributed along the coast at thirty miles or more from shore, and is often taken close to land. Both the asexual and sexual generations usually occur together, the latter in larger numbers, but neither as a rule forming great swarms. The chains of this species are often a noticeable feature of the surface fauna as seen on a calm night at sea, floating past at a depth of a few feet, the "nucleus" showing of a dead white colour in the rays of a light held close to the water, the rest of the animal being invisible. The solitary forms may at such times be distinguished by the reddish tinge of their nucleus. The chains reach an apparent length of two or three feet, but invariably break up when taken from the water. The zooids composing them seem to attain their full size while still attached.

The spinulose form of the sexual generation was taken on one occasion, May 20th, 1905, fifty miles N. by W. of Eagle Island, Co. Mayo, Mesoplankton trawl, 1,150 fathoms, when 56 large echinate forms were found, together with about 100 large and 600 small sexual zooids of the typical shape. These specimens seem to bear out Ritter's view (1905, p. 69), expressed with reference to the asexual generation, that spinulation is acquired as a mark of age, as the spinulose forms have the larger body, though their total length is only equal to that of the smooth specimens owing to the shortening and thickening of the anterior and posterior processes. They have a strongly marked spinose dorso-lateral ridge running to the extreme ends of both anterior and posterior processes, and not, as in the specimen figured by Prof. Herdman (1888, Pl. VI., fig. 5), confined to the posterior process. The total length of an average specimen is 4·6 cm., the distance from branchial to atrial opening being 2·2 cm. In a typical *S. fusiformis* of the same length this distance is only 1·4 cm., while in one measuring 6·2 cm. it is 2·1 cm. Thus if the shortening of the processes is the result of age the echinate form of 4·6 cm. is equivalent to the smooth form of about 6·3 cm. The musculature of the echinate form is quite in agreement with the typical *fusiformis*, but gives the appearance of the bands being thicker owing to the shortening of the animal. The solitary forms which were found in the same haul were of moderate size and quite normal in every respect.

In addition to the records given below, this species has been recorded by Miss Delap (1906, p. 18) as occurring in Valencia Harbour in September, 1903, and in June and October, 1905.

Date	Station No.	Locality.	Depth of Net. Fms.	Sexual Form.	Asexual Form.
1900.					
6/9	Monica.	2¼ mi. N.W. of High I., Co. Galway.	42	—	1 large.
7/9	Monica.	3 mi. off High I., ...	0	—	4 large, few small.
1901.					
2/7	Helga LXXX.	20 mi. N.W. by N. of Cleggan Head.	0	9 medium.	
4/7	Helga LXXXIII.	20 mi. W.N.W. of Cleggan Head.	33	60 medium and large.	
			60	1 large.	
8/7	Helga LXXXVIII.	40 mi. W.N.W. of Cleggan Head.	39	1 large.	
			76	4 large, 1 small.	
15/7	Helga XCVI.	10 mi. W.N.W. of Cleggan Head.	25	1 large, ...	1 medium.
1/8	Helga CIX.	Off Lyon Head, Co. Galway.	0	5 large.	
28/8	Helga CXXIII.	4 mi. N. by E. of Sybil Head, Co. Kerry.	50	1.	
28/8	Helga CXXV.	12 mi. W.N.W. of Loop Head, Co. Clare.	25	*ca* 100. ...	2 very small.
			50	*ca* 50 large, 50 medium.	3 small.
1903.					
2/5	S.R. 15	50 mi. W.N.W. of Tearaght, Co. Kerry.	120	1 large.	
13/7	—	50 mi. W.N.W. of Cleggan Head.	120	1 large.	
24/9	L. 252	2¼ mi. E. of Bofin, Co. Galway.	33	Common.	
			0	Scarce.	
29/9	L. 253	1 mi. N. of Cleggan Head,	{0 8}	Few.	
			17	Few, ...	1.
3/10	L. 254	2 mi. N. of Lyon Head, Co. Galway.	{0 15 30}	Few.	
6/10	L. 255	½ mi. N.N.E. of Cleggan Head.	0	Very few.	
			9	—	Few.
17/10	L. 256	3 mi. W. of Leahy Rocks, Co. Galway.	19	Few.	
			8	1, ...	1 very small.
1904.					
1/11	S.R. 153	70 mi. S.W. ½ W. of Fastnet, Co. Cork.	{20 50}	Moderate, small.	Moderate, large and small.
1905.			91	*ca* 30 small, ...	1 small.
6/5	S.R. 212	50 mi. W. ¾ N. of Tearaght,	100	6 small.	
6/5	S.R. 213	30 mi. W. ¾ N. of Tearaght,	400	Few, ...	Few.
			40	80 large, ...	4 large.
11/5	S.R. 221	53° 15′ N. 13° 17′ W., ..	0	Many, ...	Very abundant.
12/5	S.R. 222	Porcupine Bank, ...	50	60 large and small.	20 large.
			100	50 small and medium.	4 large.
			150	3 large, 20 small,	3 large.
12/5	S.R. 224	Outside Porcupine Bank,	0-700	Very abundant,	Abundant.
14/5	S.R. 227	Porcupine Bank, ...	0	15 large, 20 small,	17 large, 5 small.
			164	Very many, ...	Very many.

Date.	Station No.	Locality.	Depth of Net. Fms.	Sexual Form	Asexual Form.
1905.					
20/5	S.R. 230	30 mi. N. by W. of Eagle I., Co. Mayo.	50	1, ...	1.
20/5	S.R. 231	50 mi. N. by W. of Eagle I.,	200 400	5. —	1 large.
13/8	S.R. 239	Between Copelands and Port Patrick (off Belfast Lough).	70	15, ...	4 large
3/11	S.R. 267	10 mi. S.W. of Fastnet, ...	52	1.	

Salpa asymmetrica, Fowler.

Salpa asymmetrica, Fowler 1896, Pl. 1.
Salpa asymmetrica, Apstein, 1901, p. 8, fig. 7.

This appears to be the commonest species of Salpa occurring in Irish waters. It does not form immense shoals, as do at times *S. mucronata* and *S. fusiformis*, and the actual number of records is less than in the case of the latter species, but taking into account its extreme fragility and the number of cases in which it must have escaped detection in consequence, one may, I think, safely make the above assertion.

It is often the case that salp "nuclei" and small fragments of test apparently too much damaged for determination, form a noticeable feature in the *Helga's* townet gatherings. Closer examination sometimes reveals a portion of test sufficiently large to show the characteristic muscle banding, and in every instance this has proved to be that of *S. asymmetrica*, usually a specimen of the sexual generation. This species was first described by Dr. G. H. Fowler from a few specimens taken in the Färöe Channel, and has since been taken off the Gulf of Guinea (Apstein, 1901, p. 9) by the German deep-sea expedition. If it were not for this latter record one would be inclined to regard it as a northern species, whose permanent range stretched sufficiently far south to include the W. coast of Ireland; but it is equally probable that it is a widespread Atlantic species that has hitherto escaped detection.

The list of records below indicates a fairly uniform distribution, though not in any great numbers, twenty miles or more from shore, most of the records being from the beginning of August to the end of November.

The largest specimen of the sexual generation met with measured 1·4 cm. The asexual form reaches an equal or greater size, but was only found perfect in the case of very small specimens.

[TABLE

Date.	Station No.	Locality.	Depth of Net. Fms.	Sexual Form.	Asexual Form.
1901. 9/7	Helga XC.	40 mi. W. by S. of Cleggan Head, Co. Galway.	38	—	3.
11/9	Helga CXXIX.	40 mi. W.N.W. of Cleggan Head.	70	36, ...	2 small.
12/9	Helga CXXXI.	50 mi. W.N.W. of Cleggan Head.	50 100	—	50. 40.
13/0	Helga CXXXII.	50 mi. N.W. by N. of Cleggan Head.	120	ca 100.	
13/9	Helga CXXXIII.	40 mi. N.W. by N. of Cleggan Head.	45	3, ...	3.
1902.					
18/8	—	40 mi. W.N.W. of Cleggan Head.	48	—	1.
1903.					
8/5	S.R. 19	50 mi. W.N.W. of Tearaght, Co. Kerry.	146	6.	
7/8	S.R. 31	50 mi. W.N.W. of Tearaght.	93 120	— —	10. 1.
7/8	S.R. 32	30 mi. W.N.W. of Tearaght.	20 100	Few, ... ca 50, ...	Few. ca 200.
7/8	S.R 33	11½ mi. N.W. by W. of Tearaght.	15	I, ...	4.
10/8	S.R. 34	50 mi. W.N.W. of Cleggan Head.	75	4.	
11/8	L. 237	4½ miles W.N.W. of Inishturk, Co. Galway.	41	8.	
19/8	S.R. 51	30 mi. W.N.W. of Tearaght.	100	Very few, ...	2.
25/8	L. 243	Between Bofin and High I., Co. Galway.	14	—	2.
11/11	S.R. 60	30 mi. W.N.W. of Cleggan Head.	30	3, much broken.	
15/11	S.R. 71	30 mi. N.N.W. of Rathlin O'Beirne, Co. Donegal.	25	30.	
15/11	S.R. 72	22 mi. N.N.W. of Rathlin O'Beirne, Co. Donegal.	20	3.	
1904.					
11/8	S.R. 138	41 mi. N. by W. of Eagle I., Co. Mayo.	0	—	60.
11/8	S.R. 139	50 mi. N. by W. of Eagle I.	0–400 0–600 0–800	— — —	
23/8	S.R. 115	50 mi. W.N.W. of Slyne Head, Co. Galway.	112	Few.	
24/8	S.R. 146	80 mi. W.N.W. of Slyne Head.	0	—	30 ? much broken.
1905.					
8/11	S.R. 275	50 mi. W.N.W. of Cleggan Head.	40 120	Very few. Very few.	

Salpa zonaria, Pallas.

Salpa cordiformis-zonaria, Traustedt, 1885, Pl. I., figs. 10-11.

Salpa cordiformis-zonaria, Herdman, 1888, p. 70, Pl. VII., figs. 1-9.

Salpa zonaria, Apstein, 1894, pp. 36-37.

Salpa zonaria, Apstein, 1901, p. 10, fig. 10.

Salpa zonaria-cordiformis, Ritter, 1905, p. 76, figs. 20-21.

This species is very widely distributed in the N. Atlantic, but does not seem to occur in large shoals. It has been recorded from as far N. as Cape Farewell and Iceland (Apstein, 1894, p. 36), and was taken by the Plankton Expedition in the neighbourhood of the Azores and Cape Verde Islands and in S. Equatorial current (Traustedt, 1893, p. 6). It seems to be only an accidental immigrant into the Irish area.

All the records below refer to the sexual generation of the species.

Date.	Station No.	Locality.	Depth of Net. Fms.	Sexual Form.	Asexual Form.
1903.					
8/6	S.R. 19	50 mi. W.N.W. of Tearaght, Co. Kerry.	100	1 medium.	
1905.					
3/2	S.R. 188	50 mi. W. ¾ N. of Tearaght.	350	2 large.	
11/5	S.R. 221	53° 15′ N. 30° 17′ W., ...	0	2 large.	

Pyrosoma spinosum, Herdman.

Pyrosoma spinosum, Herdman, 1888, p. 29, Pl. II., figs. 9-15.
Pyrosoma excelsior, Perrier, 1886, p. 229.

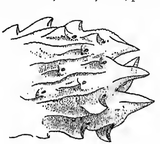

Fig. 2.

The genus Pyrosoma is represented by a single very young colony which I have referred to *P. spinosum*, as it possesses all the main features of that species though showing some small differences which may be put down to immaturity.

The capture of this small colony is of interest, as the recorded specimens of *P. spinosum* are only three in number and were all of large size, one having been taken by the *Talisman* and two by the *Challenger*. The colony is imperfect, the closed ventral end having been broken off. The remaining portion, with the common cloacal aperture, is somewhat crushed but otherwise well preserved. The specimen as it

stands measures about 1·5 cm. in length, by ·9 cm. in diameter. The walls of the colony are about 2 mm. thick. The dorsal opening is about 2·5 mm. in diameter, and is guarded by four triangular pyramidal processes, which presumably belonged to the four original zooids.

The zooids are too small to investigate satisfactorily. In one, measuring 1·5 mm. in length, the longitudinal bars are at least twenty in number, and the transverse vessels twenty-four, or possibly more. Seven dorsal languets were made out in one specimen, but it appeared as if others had been broken off. The branchial aperture of each zooid is irregularly lobed, the ventral lobe being slightly the largest; the lobes are not produced into distinct tentacles, as in the full-grown *P. spinosum*.

A stout, sharply-pointed, curved spine or process of the test with ventral and lateral keels, is situated ventrally to each branchial pore, and partially overhangs it. The curve of the spine is directed towards the common aperture, so as to offer least resistance, as Herdman suggests, to the passage of the colony through the water. The situation of the test processes ventral to the branchial openings of the zooids is a character only found in *P. spinosum*. In other species the processes are dorsal to the openings or entirely absent.

The disposition of the zooids and spines seems to be more or less regular. They are arranged alternately in vertical rows, there being about sixteen rows in the circumference of the colony. It is possible, however, that in the figure the arrangement is shown as being more symmetrical than it is in reality. Between each row is a thin vertical ridge with a fine crenulated edge rising in places into a low crest.

Through the kindness of Dr. R. N. Wolfenden I have had an opportunity of examining two large specimens of *P. spinosum* taken by his yacht, the *Silver Belle*, in 200 fathoms, off Cape St. Mary, Portugal, in March, 1906, and I hope to be able to deal with them shortly elsewhere.

Date.	Station No.	Locality.	Depth of Net. Fms.	—
1903.				
4/2	S.R. 299	95 mi. S.W. by W. ½ W. of Fastnet, Co. Cork.	500	One specimen in townet on trawl.

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SECOND REPORT ON THE COPEPODA OF THE IRISH ATLANTIC SLOPE,

BY

G. P. Farran, B.A.

Plates I–XI.

The list of species here given is the result of a number of deep-water townettings taken off the West coast of Ireland in 1904-5, and may be regarded mainly as a contribution to our knowledge of the plankton of the region lying between soundings of 600 and 1,000 fathoms.

The principal net used on each station was either a large triangular townet of coarse silk or mosquito-netting, each side of the mouth measuring six feet, or else a mesoplankton trawl, of Dr. C. G. J. Petersen's design, of coarse sereen cloth. At intervals along the wire warp carrying the main net were fixed smaller ring townets without bridles, the rings being fastened directly to the warp, so that they remained vertical and thus were partially closed while the nets were being hauled. These serial townets, when they arrived at the surface in safety, furnished a check, when estimating the error caused by the fishing of the nets during ascent, by giving some indication of the fauna of intermediate depths.

The following list gives the positions of the various stations and the nature and depths of the townets used on each of them. It will be seen that four of them, viz., S.R.139, S.R.140, S.R.197, and S.R.231, are just outside the Irish deep-water area as marked by the 1,000-fathom line, while one, S.R.193, is about on the boundary line, but on which side of it it is impossible to say, as bottom soundings were not taken.

It should be noted that in the following pages the captures of each species are regarded as having taken place at the depth at which the net is recorded to have been fishing, any instances in which this view seems to lead to error being specially referred to. The depth of the net is deduced from the length of warp with which it was fished, and must consequently be regarded as approximate; the possible error is not, however, sufficient to have any serious effect on the results.

Station S.R. 139. 50 miles N. by W. of Eagle Island, Co. Mayo, lat. 55° 0′ N., long. 10° 48′ W. soundings $\overline{1000}$ fath.,

11th August, 1904.

Medium silk net[1], surface.	Medium silk net[1], 600 fath.
" " " 100 fath.	" " " 800 fath.
" " " 200 fath.	" " " 1,000 fath.
" " " 400 fath.	Mesquito-net Δ[2], 1,000 fath.

[1]Bolting silk, 25 openings to 1 cm.
[2]Triangular net, sides 6 feet.

Fisheries, Ireland, Sci. Invest., 1906, *II*, [*Published, June*, 1908].

Station S.R. 140. 40 miles N. by W. of Eagle Island, Co. Mayo, lat. 54° 50′ N., long. 10° 45′ W., soundings $\overline{1000}$ fath.

11th August, 1904.

Medium silk net[1], surface.
" " " 330 fath.
" " " 530 fath.
Mosquito-net Δ[2], 730 fath.

Station S.R. 164. 50 miles W.N.W. of Tearaght, Co. Kerry, lat. 52° 6′ N., long. 12° 0′ W., soundings, 375 fath.

3rd November, 1904.

Medium silk net[1], 100 fath.
" " " 200 fath.
Coarse silk Δ[3], 350 fath.

Station S.R. 175. 40 miles N. by W. of Eagle Island, Co. Mayo, lat. 54° 53′ N., long. 10° 42′ W., soundings, $\overline{670}$ fath.

14th November, 1904.

Medium silk net[1], 600 fath.
Coarse silk Δ[3], 600 fath.

Station S.R. 193. 40 miles N. by W. of Eagle Island, Co. Mayo, lat. 54° 50′ N., long. 10° 30′ W., soundings $\overline{650}$ fath.

10th February, 1905.

Fine silk net[4], surface.	
Coarse silk[5] and cheese cloth[6] net,	230 fath.
" " " "	430 fath.
Coarse silk net[3],	530 fath.
Fine silk net[4],	630 fath.
Coarse silk Δ[3],	630 fath.

Station S.R. 197. 50 miles N. by W. of Eagle Island, Co. Mayo lat. 54° 57′, long. 10° 51′ W., soundings $\overline{1000}$ fath.

11th February, 1905.

Coarse silk[5], and cheese cloth[6] net,	80 fath.
" " " "	280 fath.
" " " "	480 fath.
Coarse silk net[3],	580 fath.
Fine silk net[4],	680 fath.
Coarse silk Δ[3],	680 fath.

Station S.R. 224. Off the Porcupine Bank, lat. 53° 7′ N., long. 15° 6′ W., soundings 860 fath. 12th May, 1905.

Petersen Mesoplankton Trawl[7], 700 fath.

[1]Bolting silk, 25 openings to 1 cm.
[2]Triangular net, sides 6 feet.
[3]Grit gauze, 9 openings to 1 cm.
[4]Bolting silk, 50 openings to 1 cm.
[5]Bolting silk, 14 openings to 1 cm.
[6]*Ca.* 10 openings to 1 cm.
[7]*Ca.* 7 openings to 1 cm.

Station S.R. 231. 50 miles N. by W. of Eagle Island, Co. Mayo, lat. 55° 1′ N., long. 10° 45′ W., soundings 1,200 fath.

20th May, 1905

Coarse silk[1] and cheese cloth[2] net, 200 fath.
" " " " 400 fath.
Coarse silk Δ[3], 750 fath.
Petersen Mesoplankton Trawl[4], 1,150 fath.

The most noticeable features of the copepod fauna of the region investigated are the very large number of species represented and the uniformity with which they occur. The first of these facts has been made familiar by the lists published by Professor G. O. Sars, Dr. Wolfenden, and the late I. C. Thompson. The second might, perhaps, be inferred from the fairly uniform conditions of light and temperature, but has not been duly emphasised as regards the copepoda. It is, I think, better shown by lengthy hauls with large nets, such as those here dealt with, than by gatherings of small bulk, which, when large numbers of species are present in small quantities, must necessarily contain only a small proportion of the species actually represented. This objection is, of course, equally to be urged against any deductions made from the contents of the small serial townets referred to above.

The number of species recorded below is 164, and of these about 120 may be reckoned as permanent members of the skotoplankton, that is to say in this locality, and may be expected to occur in any townet which is towed within the region of observation at the appropriate depth for a sufficient length of time. Though a few species, such as *Acartia Clausi*, *Calanus finmarchicus*, *Metridia lucens* and *Euchaeta norvegica*, are present in much larger numbers than the rest; yet there is no indication of the presence of any particular species in swarms such as are found in shallow or inshore waters. The nearest approach to such a swarm is in the case of *Scolecithricella dentata* at 200 fathoms on Station S.R. 164, when that species formed ten per cent. of the gathering.

A selection from the temperature and salinity observations made on the townet stations is here given to illustrate the physical conditions under which the gatherings were made.

AUGUST, 1904.

Station S.R. 139.		Station S.R. 140	
Depth in Fath.	Temperature.	Depth in Fath	Temperature.
1	14·6	0	14·5
10	14·6	10	14·6
60	10·0	67	10·0
94	9·46	98	9·46
500	8·4	480	8·7
800	7·0		

[1]Bolting silk, 14 openings to 1 cm.
[2]*Ca.* 10 openings to 1 cm.
[3]Grit gauze, 9 openings to 1 cm.
[4]*Ca.* 7 openings to 1 cm.

NOVEMBER, 1904.

STATION S.R. 164.

Depth in Fath.	Temp.	Salinity.
1	13·2	—
10	13·2	—
50	11·2	35·55
100	10·6	—
150	10·4	35·62
200	10·23	35·59
350	9·78	35·70

STATION S.R. 175.

Depth in Fath.	Temp.	Salinity.
0	10·9	35·44
10	10·7	—
50	10·7	—
90	10·0	—
200	9·5	35·39
400	9·05	35·48
670	4·5	35·46

FEBRUARY, 1905.

STATION S.R. 193.

Depth in Fath.	Temp.	Salinity.
0	9·6	35·41
10	9·4	—
50	9·5	—
100	9·55	35·39
300	9·57	35·41
480	9·2	—

STATION S.R. 197.

Depth in Fath.	Temp.	Salinity.
0	9·5	35·43
10	9·7	—
50	9·5	35·34
100	9·6	35·41
200	9·6	35·37

MAY, 1905.

STATION S.R. 224.

Depth in Fath.	Temp.	Salinity.
0	10·7	35·32

STATION S.R. 231.

Depth in Fath.	Temp.	Salinity.
0	10·9	35·28
10	9·9	—
53	9·3	—
100	0·3	35·23
150	0·2	35·19
300	8·9	—

In considering the physical conditions under which the townettings were made we may treat of them in four groups according to the months in which the observations were made, one or two of the stations in each group being located in approximately the same position, viz., 40 to 50 miles N. by W. of Eagle Island, County Mayo.

The stations S.R. 139 and S.R. 140 taken in August, 1904, may be considered as identical in position. No salinity observations were taken, but, judging from the International Bulletin for that month, the north-eastward extension of the highly saline oceanic water was greatly reduced, the surface isohaline of 55·5 apparently stopping short at lat. 50° N.

In November, 1904, one station, S.R. 175, was taken in the usual position 40 miles N. by W. of Eagle Island, and the other, S.R. 164, 50 miles W.N.W. of Tearaght, County Kerry. The saline conditions as indicated by the observations and the International charts show a tongue of water of fairly high salinity, reaching up from the southward and keeping close in to the coast, the base of the tongue off Tearaght being considerably salter than its northward extension. The Tearaght station thus differs from the rest both in its southern position and consequent

high salinity, and also in its moderate depth, so that faunistic differences must not be ascribed to one cause without consideration of the other.

The two stations taken in February, 1905, may be considered together. The salinity conditions during that month were practically identical with those of November, 1904, but the temperature of the water showed a fall of about 1° C. in the upper layers.

In May, 1905, observations show that the flow of highly saline water from the southward, while continuing its northward extension even further than in February, had moved away from the coast, and sweeping far outside the Porcupine Bank, had stretched thence N.E. to the North of Scotland, the water on station S.R. 231 off Eagle Island falling to 35·28 at the surface, and 35·19 at 150 fathoms, and on station S.R. 224 taken outside the Porcupine Bank only reaching 35·32 at the surface.

Applying these considerations to the faunistic lists we should expect to find that stations S.R. 139, S.R. 140, and S.R. 231, taken when the southerly flow was farthest from the coast, contained the smallest proportion of southern species, while in S.R. 164 the presence of southern forms should be more noticeable than in the rest. Stations S.R. 175, S.R. 193, and S.R. 197 should also contain a high southern percentage, while the position of S.R. 224, 180 miles from shore, should counterbalance its lower salinity. These four sub-divisions I have referred to respectively as N. S. M. and O.

These expectations are not very fully borne out by the results, probably because the effects of the periodic northerly drift are greatly diminished at the depths at which most of the specimens were taken.

Putting aside eleven species as being too small for capture except in fine silk nets, and 101 species which may be regarded as indigenous, being common to the stations of both high and low salinity, we find that there are twenty-five species peculiar to N. or N. and O. Nine of these are new, and may or may not represent northern forms. Two, *Cetropages hamatus* and *Temora longicornis*, are members of the coastal fauna, and with them should probably be reckoned *Euchirella rostrata*. One, *Undinella oblonga*, is only known as Polar, and the remaining eleven are probably temperate N. Atlantic forms, six of them being species recently described by Prof. G. O. Sars from the Prince of Monaco's collections.

Taking next those species which occur in M. or S. but not in N., we find that out of twenty-four species there are nine which may be regarded as of Southern origin. These are :—

Calanus gracilis.	*Xanthocalanus typicus.*
Calocalanus styliremis.	*Phaenna spinifera.*
**Clausocalanus arcuicornis.*	*Pleuromamma abdominalis.*
**Aetideus Giesbrechti.*	**Augaptilus palumboi.*
**Euchaeta acuta.*	

The majority of these, which I have marked with an asterisk, are more or less epiplanktonic in their habits, and possibly they may all prove to be so. The remaining fifteen are made up of five new species, one, *Haloptilus acutifrons*, which ranges to the Arctic Ocean, and nine of whose distribution not much is known.

Of the four species peculiar to O., one, *Scolecithrix valida*, is new, and the remainder, *Eucalanus attenuatus*, *Lucicutia longiserrata* and *Augaptilus pavoninus* may, I think, be regarded as oceanic species, the position being probably a more important factor than the salinity.

The number of new species described is thirty, three of them being made types of new genera, the list being as follows :—

Mimocalanus cultrifer, gen. et sp. nov.,
Mimocalanus nudus,
Oxycalanus spinifer, gen. et sp. nov.,
Spinocalanus spinosus,
Chiridius gracilis,
Gaidius validus,
Gaidius parvispinus,
Euchirella Wolfendeni.
Euchaeta Sarsi,
Euchaeta Scotti,
Euchaeta quadrata,
Euchaeta rubicunda,
Valdiviella insignis,
Undinella brevipes,
Scolecithrix gracilipes,
Scolecithrix globiceps,
Scolecithrix valida,
Lucicutia lucida,
Heterorhabdus robustus,
Haloptilus tenuis,
Haloptilus fons,
Augaptilus facilis,
Augaptilus similis,
Augaptilus horridus,
Augaptilus anceps,
Phyllopus Helgae,
Phyllopus impar,
Candacia gracilimana,
Paroithona parvula, gen. et. sp. nov.,
Oncaea exigua,
Oncaea obscura,
Lubbockia brevis.

Four of these have already been recorded by me (1905) from the west coast of Ireland under pre-existing names, but I have since been convinced of their specific distinctness. *Chiridius gracilis* accordingly replaces the record of *Chiridius Poppei*, *Heterorhabdus robustus* that of *Heterorhabdus vipera*, and *Phyllopus Helgae* and *Phyllopus impar* must jointly take the place of *Phyllopus bidentatus*.

As the collections were mostly made just outside the 1,000-fathom line, it is pretty certain that all the species enumerated are to be found either permanently or periodically within the British-and-Irish deep-water area, though absolute proof is only adducible in the case of those taken on stations S.R. 164, S.R. 175, and S.R. 224.

TABLE OF OCCURRENCE OF SPECIES.

The symbols indicate the relative abundance of the various species in each townetting, their signification being as follows:—

A = abundant or over 45%.
C = common or 20–45%.
M = moderate or 10–20%.
F = few or 5–10%
+ = very few or less than 5%.

TABLE OF OCCURRENCE OF SPECIES.

	Station No.,	S.R. 130.								S.R. 149.				S.R. 164.			S.R. 17	
	Depth in Fathoms,	0.	100.	200.	400.	600.	800.	1,000.†	1,000.§	0.	330.	530.	730.§	100.	200.	350.‡	600.†	800.†
1	Calanus finmarchicus, ..	+	+	F.	F.	M.	M.	M.	+	+	M.	F.	..	..	+	M.	F.	M.
2	C. hyperboreus, ..	..	..	..	..	..	..	+	+	..	..	..	..	..	..	..	..	..
3	C. tenuicornis, ..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+
4	C. gracilis, ...	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	+	..
5	Megacalanus princeps, ..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
6	M. longicornis, ..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	+
7	Eucalanus elongatus, ..	..	+	..	+	+	+	+	+	+	+	+	+	..	..	M.	+	F.
8	E. crassus, ...	..	+	+	..	..	+	+	..	..	+	+	..	..	..	+	+	+
9	E. attenuatus, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
10	Rhincalanus nasutus, ..	+	+	+	+	+	+	+	..	..	+	+	+	+	..	F.	+	F.
11	Paracalanus parvus, ..	C.	+	+	+	F	+	+	..	A.	+	F.	..	F.	+	..	+	..
12	Calocalanus styliremis, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
13	Mimocalanus cultrifer, ..	..	..	..	+	+	+	+	..	..	..	..	..	..	..	..	+	..
14	M. nudus, ...	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
15	Oxycalanus spinifer, ..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
16	Spinocalanus abyssalis,	..	..	+	+	+	+	+	..	..	+	+	..	..	..	+	+	+
17	S. magnus, ...	..	..	+	+	+	+	+	..	+	+	+	..	..	..	+	+	..
18	S. spinosus, ...	..	..	..	..	..	+	+	..	..	..	+	..	..	..	+	+	+
19	Pseudocalanus elongatus,	..	+	+	+	+	+	+	..	..	+	..	..	+	..	..	+	..
20	Microcalanus sp., ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
21	Clausocalanus arcuicornis,	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
22	Ctenocalanus vanus, ..	..	+	..	+	+	..	+	..	..	+	..	..	+	..	..	+	..
23	Aetideus armatus, ..	..	F.	..	+	+	+	+	..	+	+	+	..	F.	+	..	+	+
24	A. Giesbrechti, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
25	Faroella multiserrata, ..	..	..	..	+	+	..	+	..	..	..	+	..	..	..	..	+	+
26	Chiridius armatus, ..	..	..	..	+	+	+	+	+	..	+	..	..	..	..	F.	+	+
27	C. gracilis, ...	..	..	..	+	..	+	+	..	..	+	..	..	..	..	..	+	+
28	Pseudenchaeta brevicauda.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
29	Gaidius tenuispinus, ..	..	..	..	+	..	+	+	..	+	+	+	..	..	..	..	+	+
30	G. affinis, ...	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
31	G. notacanthus, ..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	+
32	G. parvispinus, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
33	G. validus, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
34	Gaetanus pileatus, ..	..	..	+	+	..	+	+	+	..	+	..	+	..	..	+	+	+

* Fine silk net. † Medium silk net. ‡ Coarse silk triangular net

TABLE OF OCCURRENCE OF SPECIES.

S.R. 193.						S.R. 197.						S.R. 224.	S.R. 231.				Station No.
0.	230.	330.	530.	630.*	630.‡	80.	280.	480.	580.	680.*	680.‡	700.§	200.	400.	750.‡	1,150.‖	Depth in Fathoms.
..	+	C.	..	F.	C.	..	C.	C.	M.	F.	C.	+	C.	C	F	+	Calanus finmarchicus.
..	..	..	..	..	+	..	..	..	+	+	+	+	..	..	+	..	C. hyperboreus.
+	..	..	..	+	..	..	..	..	..	+	..	..	..	..	..	..	C. tenuicornis.
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	C. gracilis.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	Megacalanus princeps.
..	..	..	..	..	+	..	..	..	+	..	+	+	..	..	..	+	M. longicornis.
..	..	..	+	+	+	..	+	+	F.	+	+	+	+	+	..	+	Eucalanus elongatus.
..	..	..	..	+	+	..	..	..	..	+	+	+	..	..	..	..	E. crassus.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	E. attenuatus.
..	+	+	+	+	+	..	+	+	+	+	+	F.	+	+	+	+	Rhincalanus nasutus.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Paracalanus parvus.
..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	Calocalanus styliremis.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Mimocalanus cultrifer.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	M. nudus.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Oxycalanus spinifer.
..	..	+	..	+	+	..	+	..	..	+	+	..	..	+	..	..	Spinocalanus abyssalis.
..	..	..	..	+	+	..	+	..	..	F.	+	+	..	..	..	..	S. magnus.
..	..	+	..	+	+	..	..	..	..	+	+	..	..	..	..	..	S. spinosus.
+	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	Pseudocalanus elongatus.
..	..	..	..	+	..	..	..	..	..	+	..	..	..	..	..	..	Microcalanus sp.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Clausocalanus arcuicornis.
+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Ctenocalanus vanus.
..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	Aetideus armatus.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	A. Giesbrechti.
..	..	..	..	+	+	..	..	+	+	+	+	..	..	+	..	..	Faroella multiserrata.
..	..	+	+	+	F.	..	+	+	+	+	+	+	..	..	F.	..	Chiridius armatus.
..	..	..	..	..	+	..	+	+	+	..	+	..	..	+	..	..	C. gracilis.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	Pseudeuchaeta brevicauda.
..	..	..	..	+	+	..	+	..	+	+	+	+	..	+	+	..	Gaidius tenuispinus.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	+	+	G. affinis.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	+	+	G. notacanthus.
..	..	..	..	..	..	..	..	..	+	+	+	..	..	..	..	..	G. parvispinus.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	G. validus.
..	..	+	F.	+	+	..	+	+	+	+	+	F.	..	+	+	+	Gaetanus pileatus.

§ Mosquito-net triangular net. ‖ Meso-plankton trawl.

TABLE OF OCCURRENCE OF SPECIES—*continued.*

Station No.,		S.R. 139								S.R. 140.				S.R. 104.			S.R. 175.	
	Depth in Fathoms,	0.	100.	200.	400.	600.	800.	1,000.†	1,000.§	0.	330.	530.	730.§	100.	200.	350.‡	600.†	600.‡
35	Gaetanus miles, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
36	G. latifrons, ...	..	..	..	..	..	..	..	+	..	..	..	+	..	..	+	+	+
37	G. major, ...	..	..	..	+	+	+	+	+	..	+	+	+	..	..	+	+	+
38	G. minor, ...	..	..	..	+	..	..	..	+	..	..	..	..	..	..	+	+	+
39	Undeuchaeta major, ..	..	..	..	..	..	+	..	+	..	+	+	+	..	..	+	+	+
40	U. minor, ...	..	..	..	..	..	+	..	..	..	..	+	+	..	..	F	+	+
41	Chirundina Streetsi, ..	..	..	..	..	..	..	..	+	..	..	+	+	..	..	+	+	+
42	Euchirella messinensis,	+	+	..	..	..	..	..	..	..	..	..	+	..	..	+	..	+
43	E. galeata, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..
44	E. maxima, ...	..	..	..	..	..	+	..	+	..	..	..	..	..	..	+	+	..
45	E. curticauda, ..	+	+	..	..	..	+	+	+	..	..	..	+	..	..	+	+	+
46	E. rostrata, ...	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
47	E. Wolfendeni, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
48	E. obtusa, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
49	Euchaeta acuta. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..
50	E. norvegica, ..	..	..	+	+	+	+	+	A.	..	+	+	A.	..	..	M.	+	C.
51	E. barbata, ...	..	..	..	..	..	..	..	+	..	..	..	+	..	..	..	..	..
52	E. Sarsi, ...	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
53	E. Scotti, ...	..	..	..	..	..	..	..	+	..	..	..	+	..	..	..	..	..
54	E. quadrata, ..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	+	..	..
55	E. rubicunda, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
56	E. tonsa, ...	..	..	..	+	..	..	+	+	..	..	..	..	..	..	..	+	+
57	E. bisinuata, ..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
58	Valdiviella insignis, ..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
59	Chiridiella macrodactyla,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
60	Pinauna spinifera. ..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	+	+	..
61	Xanthocalanus typicus,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62	X. Greeni, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
63	Cephalophanes refulgens,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
64	X. pinguis, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
65	Onchocalanus cristatus,	..	..	..	..	..	..	..	+	..	..	..	+	..	..	..	..	..
66	O. hirtipes, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
67	Cornucalanus chelifor, ..	..	..	..	..	..	+	..	+	..	..	..	+	..	..	..	+	..
68	Undinella oblonga, ..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
69	U. brevipes, ...	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..

* Fine silk net. † Medium silk net. Coarse silk triangular net.

TABLE OF OCCURRENCE OF SPECIES—*continued*.

S.R. 193.						S.R. 197.						S.R. 224.	S.R. 231.				Station No.
0.	230.	330.	530.	630.*	630.‡	80.	280.	480.	580.	680.*	680.§	700.‡	200.	400.	750.‡	1,150.‖	Depth in Fathoms.
..	..	..	..	..	..	..	..	..	..	+	..	+	..	+	..	..	G. miles.
..	..	+	..	..	+	..	..	+	+	+	+	+	..	..	+	+	G. latifrons.
..	..	+	+	+	+	..	+	+	+	+	+	F.	..	..	+	+	G. major.
..	..	..	..	..	+	..	..	+	..	..	..	..	..	..	..	..	G. minor.
..	..	..	..	+	+	..	..	+	+	..	+	+	..	+	..	+	Undeuchaeta major.
..	..	..	..	..	+	..	..	..	..	..	+	+	..	+	..	+	U. minor.
..	..	..	..	+	+	..	+	..	..	..	+	+	..	..	..	+	Chirundina Streetsi.
..	..	..	..	..	+	..	..	..	..	..	..	+	..	..	..	..	Euchirella messinensis.
..	..	..	..	..	+	..	..	..	..	..	+	+	..	..	..	..	E. galeata.
..	..	..	..	..	+	..	..	..	..	..	..	+	..	..	..	..	E. maxima.
..	..	..	..	+	+	..	+	+	..	+	+	+	+	+	+	+	E. curticauda.
..	..	..	..	..	..	..	..	..	..	..	..	+	+	+	+	+	E. rostrata.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	E. Wolfendeni.
..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	..	+	E. obtusa.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	Euchaeta acuta.
..	..	+	F.	..	M.	+	+	+	M.	+	M.	C.	F.	+	C.	A.	E. norvegica.
..	..	..	..	..	..	..	..	..	..	+	..	+	..	..	+	+	E. barbata.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	E. Sarsi.
..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	..	+	E. Scotti.
..	..	..	..	..	+	..	..	..	..	..	+	+	..	..	..	..	E. quadrata.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	E. rubicunda.
..	..	..	+	..	+	..	..	+	+	..	+	+	..	..	+	+	E. tonsa.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	E. bisinuata.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	Valdiviella insignis.
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	Chiridiella macrodactyla.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Phaenna spinifera.
..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	Xanthocalanus typicus.
..	..	..	..	..	..	..	..	..	..	+	..	+	..	..	..	+	X. Greeni.
..	..	..	..	+	+	..	..	..	+	+	+	..	..	..	..	..	Cephalophanes refulgens.
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	X. pinguis.
..	..	+	..	..	+	..	..	.	+	+	+	+	..	..	+	+	Onchocalanus cristatus.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	O. hirtipes.
..	..	+	..	..	+	..	..	..	+	..	+	+	..	..	+	+	Cornucalanus chelifer
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Undinella oblonga.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	U. brevipes.

§ Mosquito-net triangular net. ‖ Meso-plankton trawl.

TABLE OF OCCURRENCE OF SPECIES—*continued.*

Station No.		S.R. 130.								S.R. 140.				S.R. 164.			S.R. 17	
	Depth in Fathoms,	0.	100.	200.	400.	600.	800.	1,000.†	1,000.§	0.	330.	530.	730.‡	100.	200.	350.‡	000.†	,000.‡
70	Scolecithricella dentata,	..	..	+	+	..	+	+	..	..	+	..	..	..	F.	+	+	+
71	S. ovata, ...	..	..	..	+	+	+	+	..	+	+	+	..	..	..	..	+	..
72	S. minor, ...	..	+	..	+	+	+	+	..	..	+	..	..	..	+	..	+	..
73	Scolecithrix magna, ..	..	..	..	+	..	..	..	+	..	+	+	+	..	..	+	+	F.
74	S. echinata, ...	..	..	..	+	..	+	..	..	..	..	+	..	..	..	+	+	..
75	S. gracilipes, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
76	S. obtusifrons, ..	..	..	..	+	..	..	+	..	..	+	..	+	..	..	..	..	+
77	S. globiceps, ..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
78	S. valida, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
79	S. robusta, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
80	Scottocalanus securifrons,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	+
81	S. persecans, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	+
82	Lophothrix frontalis, ..	..	..	..	..	+	..	..	+	..	+	..	+	..	..	..	..	..
83	Centropages typicus, ..	..	..	+	+	..	+	+	..	+	+	..	..	..	..	..	+	..
84	C. hamatus, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
85	Temora longicornis, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
86	Temoropia mayumbaensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
87	Metridia lucens, ..	+	C.	C.	M.	M.	C.	C.	..	+	C.	C.	..	+	F.	F.	C.	+
88	M. venusta, ...	..	..	..	+	+	+	+	..	..	+	..	..	..	..	+	+	+
89	M. brevicauda, ..	..	..	..	+	+	+	+	..	+	..	+	..	..	..	+	+	+
90	M. princeps, ..	..	..	..	..	..	..	+	+	..	..	..	+	..	..	+	+	+
91	Pleuromamma abdominalis.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+
92	P. robusta, ...	+	..	+	+	+	+	+	..	+	+	+	..	..	..	M.	+	F.
93	P. xiphias, ...	..	..	..	..	..	+	..	..	..	..	..	..	..	..	+	+	+
94	P. gracilis, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	+
95	Lucicutia grandis, ..	..	..	..	..	..	+	+	+	..	..	..	+	..	..	..	..	..
96	L. magna, ...	..	..	..	+	+	+	+	..	..	+	+	..	..	..	+	+	+
97	L. lucida, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
98	L. curta, ...	..	..	..	..	+	+	+	..	+	+	+	..	..	..	..	+	+
99	L. longiserrata, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
100	L. flavicornis, ..	..	..	..	..	..	..	+	..	..	..	..	..	..	+	..	+	..
101	Heterorhabdus norvegicus	..	..	..	+	+	+	+	..	+	+	+	..	..	..	..	+	+
102	H. spinifrons, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	+	+
103	H. abyssalis, ..	..	..	..	..	+	..	+	..	..	..	..	..	..	..	..	..	..
104	H. robustus, ..	..	..	..	..	..	+	+	..	..	+	..	..	..	..	..	+	..

* Fine silk net. † Medium silk net. ‡ Coarse silk triangular net.

TABLE OF OCCURRENCE OF SPECIES—*continued.*

S.R. 193.						S.R. 197.						S.R. 224.	S.R. 281.				Station No.
0.	230.	330.	530.	630.§	630.‡	80.	280.	480.	580.	680.§	680.‡	700.∥	200.	400.	750.‡	1,150.∥	Depth in Fathoms.
..	..	..	..	+	+	..	..	..	..	..	+	..	..	+	..	..	Scolecithricella dentata.
..	..	+	..	..	+	..	+	+	..	..	+	..	+	+	+	..	S. ovata.
..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	S. minor.
..	..	+	..	+	+	..	+	+	..	+	+	+	..	+	+	+	Scolecithrix magna.
..	..	..	..	+	+	..	..	..	..	..	+	..	..	+	..	..	S. echinata.
..	..	..	..	..	+	..	+	+	..	..	+	..	..	..	..	..	S. gracilipes.
..	..	..	..	+	+	..	..	+	..	+	+	+	..	+	+	+	S. obtusifrons.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	S. globiceps.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	S. valida.
..	..	..	..	+	+	..	..	..	+	..	+	..	..	+	..	..	S. robusta.
..	..	..	..	..	+	+	..	..	..	+	+	+	..	..	+	+	Scottocalanus securifrons.
..	..	+	..	+	+	..	..	..	..	+	+	+	..	..	..	+	S. persecans.
..	..	+	+	..	+	..	..	+	+	..	+	+	..	..	+	+	Lophothrix frontalis.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Centropages typicus.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	C. hamatus.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	Temora longicornis.
..	..	..	..	+	..	..	..	..	..	+	..	..	..	..	..	..	Temoropia mayumbaensis.
A.	A.	C.	M.	M.	M.	A.	C.	C.	F.	M.	C.	..	A.	C.	F.	+	Metridia lucens.
..	..	+	..	+	+	..	F.	+	..	+	+	+	..	+	..	..	M. venusta.
..	..	+	..	+	+	..	..	F.	..	+	+	..	..	+	..	..	M. brevicauda.
..	..	+	..	+	+	..	+	+	+	..	+	+	..	..	+	+	M. princeps.
..	+	..	..	..	..	..	..	..	+	..	+	+	..	..	..	..	Pleuromamma abdominalis.
..	+	C.	..	+	M.	F.	M.	+	M.	+	F.	..	..	C.	F.	..	P. robusta.
..	..	..	..	+	+	+	..	..	..	+	+	+	..	..	..	..	P. xiphias.
..	..	..	..	+	+	+	+	+	..	..	+	..	..	+	..	..	P. gracilis.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	F.	Lucicutia grandis.
..	..	+	+	+	+	..	..	+	+	+	..	+	..	+	..	..	L. magna
..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	L. lucida.
..	..	+	..	+	+	..	..	+	+	+	+	..	..	+	..	..	L. curta.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	L. longiserrata.
..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	L. flavicornis.
..	..	..	M.	+	F.	..	+	+	F.	+	+	+	+	+	+	+	Heterorhabdus norvegicus.
..	..	..	F.	..	+	..	+	..	+	..	+	+	..	..	..	+	H. spinifrons.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	H. abyssalis.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	H. robustus.

§ Mosquito-net triangular net. ∥ Meso-plankton trawl.

TABLE OF OCCURRENCE OF SPECIES—*continued.*

	Station No.,	S.R. 139.								S.R. 140.				S.R. 164.			S.R. 175.	
	Depth in Fathoms,	0	100.	200.	400	600	800.	1,000.†	1,000.‡	0.	330.	530.	730.‡	100.	200.	350.‡	600.†	600.‡
105	Heterorhabdus Grimaldii,	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
106	H. longicornis, ..	..	..	..	+	..	+	+	..	+	+	+	..	..	..	..	+	+
107	Mesorhabdus annectens,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
108	Disseta palumboi, ..	..	..	..	..	..	..	..	+	..	..	..	+	..	..	..	..	..
109	Haloptilus longicornis, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	+	+
110	H. acutifrons, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	+
111	H. tenuis, ...	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	+
112	H. fons, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
113	Augaptilus elongatus, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
114	A. nodifrons, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
115	A. laticeps, ...	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	+	+
116	A. brevicaudatus, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	+
117	A. facilis, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
118	A. gibbus, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
119	A. palumboi, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
120	A. bullifer, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
121	A. truncatus, ..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
122	A. similis, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
123	A. magnus, ...	..	..	..	..	+	..	+	+	..	..	..	+	..	..	+	+	+
124	A. angustus, ...	..	..	..	..	+	..	..	..	..	..	..	+	..	..	+	+	..
125	A. filigerus, ...	..	..	..	..	..	+	..	..	..	..	..	..	..	..	+	+	+
126	A. Rattrayi, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	+
127	A. horridus, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
128	A. longicaudatus, ..	..	..	..	..	..	+	..	..	..	..	..	..	+	..	+	+	+
129	A. anceps, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
130	A. megalurus, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+
131	Pontoptilus muticus, ..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..
132	P. abbreviatus, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
133	Arietellus simplex, ..	..	..	..	..	..	..	..	+	..	..	..	+	..	..	..	..	..
134	A. pavoninus, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
135	A. plumifer, ...	..	..	..	..	..	..	..	+	..	..	..	+	..	..	+	..	+
136	Paraugaptilus Buchani, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
137	Phyllopus Helgae, ..	..	..	..	+	+	+	+	..	..	+	+	..	..	..	+	+	+
138	P. impar, ...	..	..	..	..	+	..	+	..	..	..	..	..	..	..	..	..	+
139	Candacia rotundata, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	+

° Fine silk net. † Medium silk net. ‡ Coarse silk triangular net.

TABLE OF OCCURRENCE OF SPECIES—*continued.*

S.R. 193.						S.R. 197.						S.R. 224.	S.R. 231.				Station No.
0.	230.	330.	530.	630.§	630.‡	80.	280.	480.	580.	680.§	680.‡	700.‡	200.	400.	750.‡	1,150.‡	Depth in Fathoms.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	Heterorhabdus Grimaldii.
..	..	..	..	+	+	..	..	+	..	+	+	+	+	..	..	+	H. longicornis.
..	..	..	..	..	+	..	..	..	+	+	..	..	..	..	..	..	Mesorhabdus annectens.
..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	..	+	Disseta palumboi.
..	..	..	..	+	+	..	+	..	..	..	..	..	+	..	..	..	Haloptilus longicornis.
..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	H. acutifrons.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	H. tenuis.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	H. fons.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	Augaptilus elongatus.
..	..	..	..	..	+	..	..	..	+	+	+	+	..	..	..	+	A. nodifrons.
..	..	..	..	..	+	..	..	..	..	..	+	+	..	..	..	+	A. laticeps.
..	..	..	..	..	+	..	..	..	..	..	..	+	..	..	+	+	A. brevicaudatus.
..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	A. facilis.
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	A. gibbus.
..	..	..	..	+	..	..	..	+	..	..	..	..	..	..	..	..	A. palumboi.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	A. bullifer.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	A. truncatus.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	A. similis.
..	..	..	..	..	+	..	..	..	+	+	+	+	..	+	+	+	A. magnus.
..	..	..	..	..	+	..	..	..	..	..	+	+	..	..	..	+	A. augustus.
..	..	..	..	+	+	..	..	..	..	..	+	+	..	..	..	+	A. filigerus.
..	..	..	..	..	+	..	..	..	..	+	+	+	..	..	..	+	A. Rattrayi.
..	..	..	..	..	+	..	..	..	..	+	+	..	..	..	..	+	A. horridus.
..	..	..	..	..	+	..	..	..	+	+	+	+	..	..	..	+	A. longicaudatus
..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	A. aucops.
..	..	..	..	+	+	..	..	..	..	+	+	+	..	..	..	..	A. megalurus.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Pontoptilus muticus.
..	..	..	..	..	+	..	..	..	..	..	..	+	..	..	..	+	P. abbreviatus.
..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	..	+	Arietellus simplex.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	A. pavoninus.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	+	A. plumifer.
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	Paraugaptilus Buchani
+	..	..	..	+	+	..	+	+	+	..	+	..	..	+	+	..	Phyllopus Helgae.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	P. impar.
..	..	..	..	..	+	..	..	..	+	..	+	+	..	+	+	..	Candacia rotundata.

§ Mosquito-net triangular net. ‡ Meso-plankton trawl.

TABLE OF OCCURRENCE OF SPECIES—*continued.*

Station No.,		S.R. 139.								S.R. 140.				S.R. 161.			S.R. 175.	
Depth in Fathoms,		0.	100.	200.	400.	600.	800.	1,000 †	1,000 ‡	0.	330.	530.	730 ‡	100.	200.	350 ‡	600 †	600 ‡
140	Candacia norvegica, ..	..	..	..	..	+	+	+	..	..	..	+	..	..	..	..	+	+
141	C. gracilimana, ..	..	..	..	+	..	..	..	..	..	+	..	..	..	..	..	..	..
142	Anomalocera Patersoni,	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..
143	Bathypontia elongata, ..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
144	Acartia Clausi, ..	A.	C.	C.	C.	A.	C.	C.	..	F.	M.	C.	..	A.	A.	..	M.	+
145	Mormonilla phasma, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..
146	M. minor, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
147	Oithona similis, ..	+	+	..	+	+	..	+	..	+	..	+	..	..	..	..	..	..
148	O. plumifera, ..	..	M.	+	+	+	+	F.	..	..	F.	F.	..	F.	F.	..	F.	..
149	Paroithona parvula, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
150	Microsetella rosea, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
151	Clytemnestra rostrata,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
152	Aegisthus mucronatus,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+
153	Monstrilla longicornis, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
154	Oncaea mediterranea, ..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..
155	O. conifera, ..	+	M.	F	F.	F.	M.	F.	..	+	M.	M.	..	..	..	..	+	+
156	O. ornata, ..	..	..	..	..	..	+	+	..	..	..	+	..	..	..	..	+	..
157	O. notopus, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
158	O. subtilis, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
159	O. minuta, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
160	O. exigua ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
161	O. obscura, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
162	Conaea rapax,	..	..	+	..	+	+	..	..	..	..	+	..	..	..	..	+	..
163	Lubbockia brevis, ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
164	Corina granulosa, ..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..

* Fine silk net. † Medium silk net. ‡ Coarse silk triangular net.

TABLE OF OCCURRENCE OF SPECIES—*continued.*

S.R. 193.						S.R. 197.						S.R. 224.	S.R. 231.				Station No.
0.	230.	330.	530.	630.*	630.‡	80.	280.	480.	580.	680.*	680.‡	700.‡	200.	400.	750.‡	1,150.‖	Depth in Fathoms.
..	..	..	..	+	+	..	..	+	+	..	+	..	..	+	+	..	Caudacia norvegica.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C. gracilimana.
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	+	Anomalocera Patersoni
..	..	..	..	..	+	..	..	..	..	..	+	+	..	..	..	..	Bathypontia elongata.
+	..	..	..	+	..	..	..	..	..	+	..	..	..	+	..	..	Acartia Clausi.
..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	Mormonilla phasma
..	..	..	..	+	..	..	..	..	..	+	..	..	..	..	..	..	M. minor.
A.	..	..	..	F.	..	..	..	..	..	+	..	..	..	..	..	..	Oithona similis.
+	..	..	..	M.	+	..	..	..	..	F.	..	..	..	..	..	..	O. plumifera.
..	..	..	..	F.	..	..	..	..	..	+	..	..	..	..	..	..	Paroithona parvula.
..	..	..	..	+	..	..	..	..	..	+	..	..	..	..	..	..	Microsetella rosea.
..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	Clytemnestra rostrata.
..	..	..	..	..	..	..	..	..	..	..	..	+	..	+	..	..	Aegisthus mucronatus.
..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	Monstrilla longicornis.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Oncaea mediterranea.
..	..	..	..	C.	+	..	..	+	..	C.	..	..	..	+	..	..	O. conifera.
..	..	..	..	F.	..	..	..	..	..	+	..	..	..	..	..	..	O. ornata.
..	..	..	..	F.	..	..	..	..	..	+	..	..	..	..	..	..	O. notopus.
+	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	O. subtilis.
..	..	..	..	+	..	..	..	..	..	F.	..	..	..	..	..	..	O. minuta.
..	..	..	..	F.	..	..	..	..	..	+	..	..	..	..	..	..	O. exigua.
..	..	..	..	+	..	..	..	..	..	+	..	..	..	..	..	..	O. obscura.
..	..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..	Conaea rapax.
..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	Lubbockia brevis.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Corina granulosa.

‡ Mosquito-net triangular net. ‖ Meso-plankton trawl.

D

Order COPEPODA.

Sub-order Gymnoplea.

Tribe AMPHASKANDRIA.

Family *CALANIDAE.*

Genus Calanus, Leach.

Calanus finmarchicus (Gunner).

Cetochilus septentrionalis, Goodsir, 1843.

Cetochilus helgolandicus, Claus, 1863.

Calanus helgolandicus, G. O. Sars, 1903.

If Prof. G. O. Sars' view be adopted the name of this species should stand as *C. helgolandicus* as all the specimens met with belonged to the smaller species or variety.

Occurrence.—This species appears to be widely distributed at all depths investigated, and, next to *Metridia lucens* and *Acartia Clausi*, is probably the commonest copepod of the deep water adjoining our shores, though it does not occur there in such vast swarms as are found in the coastal waters of lower salinity.

Calanus hyperboreus, Krōyer.

Occurrence.—This is one of those species whose headquarters are within the Arctic Circle, but whose range is continued southwards in the colder layers of deep water. It occurred on five out of the eight stations, at depths of from 630 to 1,000 fathoms, but only very few specimens were met with at any one time.

Calanus gracilis, Dana.

Occurrence.—This is doubtless usually a surface species with an occasional small vertical distribution; but the fact that of the three captures here recorded one was at 600 and one at 630 fathoms, leads one to suppose that it sometimes descends to greater depths.

Calanus tenuicornis, Dana.

Occurrence.—This, like the preceding species, is a doubtful inhabitant of the greater depths, but the appearance of a few specimens in the fine-meshed townets at 600, 630 and 680 fathoms is in its favour, though there is a possibility that the captures may have been made during the ascent of the nets. The two other occurrences here recorded are from the surface and 100 fathoms.

GENUS **Megacalanus**, Wolfenden.

Megacalanus princeps (Brady).

Calanus princeps, Brady, 1883.

Macrocalanus princeps, Sars, 1905.

Heterocalanus medius, Wolfenden, 1906.

nec *Megacalanus princeps*, Wolfenden, 1904.

nec *Megacalanus princeps*, Wolfenden, 1905.

The simultaneous recapture of one of the finest of Brady's "*Challenger*" copepods by the Prince of Monaco, Dr. Wolfenden, the "*Helga*," and, though unrecorded, the "*Thor*," is interesting, and illustrates the renewed attention which is now being paid to deep-water plankton investigations.

As regards the inclusion of *Heterocalanus medius* in the synonomy of this species, I have compared the type specimen of *M. princeps* in the British Museum with Dr. Wolfenden's description of *H. medius* (1906), and I cannot avoid the conclusion that they are identical.

Occurrence.—This species is confined to great depths, and is much scarcer than its fellow *M. longicornis*. It was met with on three stations, viz., S.R. 139, S.R. 224 and S.R. 231, one specimen on the first at 1,000 fathoms and four on each of the others at 700 and 1,150 fathoms respectively.

Megacalanus longicornis (G. O. Sars).

Megacalanus princeps, Wolfenden, 1904.

Macrocalanus longicornis, G. O. Sars, 1905.

Megacalanus Bradyi, Wolfenden, 1905.

Occurrence.—This species is almost always captured when fishing between 600 and 1,000 fathoms, but never in large numbers and frequently immature. Possibly the fully mature individuals may be found more plentifully at greater depths.

GENUS **Eucalanus**, Dana.

Eucalanus elongatus (Dana).

Occurrence.—One of the most widely distributed copepods in the N.E. Atlantic, and apparently more common in autumn and winter, but this may perhaps be due to variations in salinity.

It occurred on every station and in 25 out of the 34 gatherings.

Eucalanus attenuatus (Dana).

Occurrence.—The headquarters of this species evidently do not lie off the west coast of Ireland, as it was only met with once during the period here dealt with, viz., on station S.R. 224, 700 fathoms, three specimens.

Eucalanus crassus, Giesbr.

Occurrence.—This species seems to be a regular member of the skoto-plankton as well as occurring at intermediate depths. It is always met with in very small numbers.

Genus Rhincalanus, Dana.

Rhincalanus nasutus, Giesbr.

Occurrence.—This species, like *Eucalanus elongatus*, is a noticeable feature of most townettings from the west coast of Ireland taken over 40 miles from shore. It was taken in 29 out of the 34 gatherings at all depths from the surface to 1,150 fathoms.

Genus Paracalanus, Boeck.

Paracalanus parvus (Claus).

Occurrence.—This species seems to be generally distributed between 500 fathoms and the surface, but is not invariably present. No conclusions can be drawn from its absence from the records of stations after S.R. 175, as the mesh of the serial townets used was too large to capture it with certainty. The same remark applies to all species of a similar size.

Genus Calocalanus, Giesbr.

Calocalanus styliremis, Giesbr.

Occurrence.—A single specimen was taken on station S.R. 197 in a 680-fathom townet, but it seems possible that the capture was made during the hauling of the net. The record, like that by Dr. Wolfenden of *Calocalanus pavo*, probably represents an accidental in-wandering from more southern regions.

Genus Mimocalanus, nov.

Female—Cephalon imperfectly fused with first thoracic segment. Fourth and fifth thoracic segments separate. Rostrum absent. Abdomen four-jointed, symmetrical. Furca short. First antenna 24-jointed, joints 8 and 9 partially fused. Second antenna with branches of about equal length. Mandible with large two-branched palp; endopodite two-jointed, larger than exopodite. Maxilla with setae on all lobes well developed, of the *Paracalanus* type. First maxillipede of the *Paracalanus* type, none of the setae being excessively developed. Second maxillipede

of the *Paracalanus* type. First to fourth feet with jointing and setae as in *Spinocalanus*, except that the outer-edge spine on the first joint of the exopodite of the first foot is absent. Terminal spines of the exopodites of second to fourth feet very broad, with finely serrate margin. No spinules on the faces of the feet. Fifth feet absent.

Male unknown.

This genus in its outward form and proportions has a very close resemblance to *Spinocalanus*, and it is to this apparent mimicry that I have referred in giving it the above name. It further agrees with that genus in having five inner-edge setae on the third joints of the endopodites of the second to fourth feet, but differs in the partial separation of the 8th and 9th joints of the first antennae, and in the absence of spinules on the inner face of the swimming feet.

Pending the discovery of the male it seems advisable to place it between the genera *Spinocalanus* and *Paracalanus*, with which latter it agrees in the absence of fusion between joints 8 and 9 of the first antenna.

Mimocalanus cultrifer, gen. et sp. n.

Pl. I, figs. 5–9.

Female—length 1·44 mm.

Cephalothorax oblong ovate in dorsal view, somewhat contracted anteriorly, very slightly vaulted. Cephalon fused with the first thoracic segment, but showing the line of suture. Fourth and fifth thoracic segments showing a very distinct line of suture, the fifth segment produced into lateral extensions rounded at the ends.

Abdomen of four segments, measuring slightly more than one-fourth of the cephalothorax. Genital segment about as long as broad, very slightly swollen ventrally. Second to fourth segments each about half as long as the genital segment. Furcal rami about as long as broad, separated by rather more than their own width.

First antenna (Pl. I, fig. 5) broken in all specimens found, but is probably as long as the whole body, 23 or 24-jointed, joints 8 and 9 partially fused in some specimens but almost separate in others.

Second antenna with the branches of equal length. No setae on the first or second joints of the exopodite, one seta each on the third to sixth joints, terminal joint with one median and three distal setae.

Mandible with two setae on the second basal joint. The endopodite consists of two elongated joints, the first with three, the second with ten setae. The exopodite is somewhat shorter than the endopodite and bears six setae. The cutting edge of the mandible bears seven teeth, the distal tooth being about twice as long as the rest.

The maxilla is of the same form as in *Paracalanus parvus*, and the number of setae on it appears to correspond closely.

The first maxillipede (Pl. I, fig. 9) bears five large setae on the first lobe and three on each of the four succeeding lobes; one seta on the third lobe, and one on the fourth, being noticeably thicker than the rest.

The second maxillipede resembles in general form and number of setae that of *Paracalanus parvus*, but the proportionate length of the joints differs slightly, the fourth and fifth joints being equal and about twice as long as the third; the sixth joint is slightly longer than the fifth.

The first foot (Pl. I, fig. 8) has a three-jointed exopodite, the first joint being without setae or spines, the second joint with one outer-edge spine and one inner-edge seta, and the third joint with one outer-edge spine, one terminal seta, and four inner-edge setae. The endopodite bears four setae, the proximal inner-edge seta being much smaller than the rest. The second basal joint carries the usual curved seta engaging with the setose outer-edge process of the endopodite.

The second foot has a two-jointed endopodite, the first joint with one inner-edge seta and the second with two terminal and two inner-edge setae.

The third and fourth feet have each a three-jointed endopodite, the first and second joints with one and the third joint with five setae. The exopodites of the second to fourth feet are three-jointed, the first and second joints each with one outer-edge spine and one inner-edge seta, the third joint with three outer-edge and one terminal spine, and five inner-edge setae. The outer-edge spines are all very well developed, and the terminal spines have very broad laminae with finely serrate margin. There are about fifty serrations on the terminal spine of the second foot.

The fifth feet are absent.

Male unknown.

In figuring the appendages of this and the following species, *M. nudus*, I have not thought it necessary to give the same appendage twice, as the resemblance between the two, except as regards size, is so close that the same figures may well be used for both

Occurrence.—This species was taken on two stations, viz.:—S.R. 139 and S.R. 175, at depths from 400 to 1,000 fathoms, and probably escaped capture or was overlooked owing to its small size on other occasions.

Mimocalanus nudus, sp. n.

Pl. I, figs. 1–4.

Female—length 2·64 mm.

Cephalon fused with first thoracic segment, slightly vaulted above, fourth and fifth thoracic segments fused, the lateral margins of the latter produced and rounded.

Abdomen measuring about one-fourth of the cephalothorax, genital segment slightly longer than the two succeeding segments taken together, very slightly swollen ventrally. Second and

third abdominal segments of about equal length, and slightly shorter than the anal segment. Furca about as long as broad, the furcal setae missing in my specimen.

First antenna incomplete, but probably slightly longer than the body.

Proportional length of joints in ·01 mm.

1.	2.	3.	4.	5.	6.	7.	8+9.	10.	11.	12.	13.	14.	15.	26.	17.	18.	19.	20.	21.	22.	23.	24.
10.	14.	7.	7.	7.	9.	8.	17.	9.	12.	13.	15.	17.	18.	18.	19.	18.	.	.	.	.	.	.

The segmentation between joints 8 and 9 is indicated, but not noticeably.

The other appendages (Pl. I, figs. 1–4) are similar to those of *M. cultrifer*.

Male unknown.

It needs a close inspection to distinguish this species from *Spinocalanus magnus*, to which, in size and appearance, it approximates very closely, but the broadly laminate terminal spines of the swimming feet will at once serve to identify it under the microscope. Its much larger size separates it from *Mimocalanus nudus*, and probably the examination of a number of specimens will reveal other points of difference from that species.

Occurrence.—One specimen was taken on station S.R. 139 at a depth of 800 fathoms.

Genus **Oxycalanus**, nov.

Female with cephalon fused with first thoracic segment. Fourth and fifth thoracic segments fused. Rostrum of two long slender ventrally directed points. Abdomen four-jointed, symmetrical. Furca short. First antenna 23-jointed, joints 8–9, and 24–25 being fused. Second antenna of the *Pseudocalanus* type, the exopodite being slightly longer than the endopodite. Mandible of the *Pseudocalanus* type, the endopodite and exopodite being about equal. Maxilla and first maxillipede of the *Pseudocalanus* type. Second maxillipede with a strong distal inner-edge spine on the first joint, but otherwise as in *Pseudocalanus*. First to fourth swimming feet with jointing and setae as in *Spinocalanus*, the posterior face of the endopodites with scanty spinulation. Fifth feet absent.

Male unknown.

This genus agrees with *Spinocalanus* in having five inner-edge setae on the third joints of the exopodites of the second to fourth swimming feet, and also in the spinules on the faces of their endopodites and on the lobes of the first maxillipede. It is, however, separated from that genus by the strong bifurcate rostrum, which resembles in some respects that of *Aetideus*.

Oxycalanus spinifer, gen. et sp. n.

Pl. I, figs. 11–17.

Female—length 2·32 mm.

Cephalothorax moderately elongate, elliptical in dorsal view. Cephalon fused with first thoracic segment, not vaulted, and

produced into a rostrum of two long straight points directed ventrally. Fourth and fifth thoracic segments fused, their lateral margins rounded and produced posteriorly, reaching almost to the middle of the genital segment.

Abdomen of four segments, contained three and a half times in length of cephalothorax. Genital segment a little shorter than second and third segments together. Fourth segment a little shorter than third and equal to the furca.

Furca with rami as long as broad, and separated by rather more than their own width. Furcal setae imperfect in my specimen.

First antenna reaching almost to the end of the genital segment, 23-jointed, joints 8-9 and 24-25 being fused, the latter not completely.

Length of joints in ·01 mm.

1.	2.	3.	4.	5.	6.	7.	8+9.	10.	11	12.	13.	14.	15.	16.	17.	18	19.	20.	21.	22.	23.	24+25.
10.	14.	6.	6.	6	6.	6.	10.	7.	7.	8	9.	10.	11.	12.	12.	12	12.	11.	10.	9.	10.	15.

Second antenna (Pl. I, Fig. 15): terminal joint of endopodite with 6 + 8 setae, exopodite rather longer than endopodite, first joint with one distal seta, second joint with two setiferous lobes and a small distal seta, third to sixth joints with the usual distal seta, terminal joint with one median and three distal setae.

Mandible of the same form as in *Pseudocalanus elongatus*.

The maxilla (Pl. I, Fig. 17) is of the same type as in *Spinocalanus*, the exopodite being well developed. The inner lobes bear, respectively, 13, 5, and 4 setae or spines, the second basal 5, the endopodite 3 + 5 + 7, the exopodite 10 and the outer lobe 9 setae.

The first maxillipede (Pl. I, Fig. 16) is of the *Pseudocalanus* type, but bears a well marked process or lump proximal to the first lobe.

First lobe with four large terminal and two smaller lateral setae, second, third, and fourth lobes each with four setae, fifth lobe with five setae, one seta on each of the fourth and fifth lobes rather larger than the rest, that on the fourth the most so.

The second maxillipede is roughly of the *Pseudocalanus* type, but the proportions differ slightly, the fourth joint being considerably longer than the third, and twice as long as the fifth. The proportionate lengths of the joints are 16 : 18 : 5 : 7 : 3½ : 4 : 1½.

The swimming feet are comparatively slender.

The first foot (Pl. I, Fig. 14) has a three-jointed exopodite, with outer-edge spines on each joint. The third joint has one terminal and four inner-edge setae. The one-jointed endopodite has a slight indication of segmentation into two, and bears five setae.

The second foot (Pl. I, Fig. 13) has two transverse rows of small setae across the posterior face of the second joint of the endopodite, and a spinose outer margin to the first basal joint.

The third (Pl. I, Fig. 12) and fourth feet have transverse rows of slender spinules on the second and third joints of their endopodites, and on the second basal joint of the fourth foot there are two transverse rows of long acicular spinules.

The terminal spines of the second to fourth feet have finely serrate laminae.

Fifth feet absent.

Male unknown.

Occurrence.—A single specimen was taken on station S.R. 139 at a depth of 1,000 fathoms.

GENUS **Spinocalanus**, Giesbrecht.

Spinocalanus abyssalis, Giesbrecht.

The great majority of the specimens found measured approximately 1·5 mm., but a few from a depth of 600 to 1,000 fathoms only reached 1·0 mm., and seemed to represent a small deep-water variety, though no differences in structure or form on which a specific discrimination might be based were observed. It is worth noting that, while the size given by Professor G. O. Sars for his Norwegian specimen is 1·6 mm., that of both the N. Polar and Pacific forms is 1·1 to 1·25 mm., a fact which precludes the idea of the existence of a northern and a southern race.

Occurrence.—This species seems to be constantly present in moderate numbers at all depths, from 200 to 1,000 fathoms.

Spinocalanus magnus, Wolfenden.

Occurrence.—This rather noticeable species, which however avoided publicity till it was recently described by Dr. Wolfenden, is very characteristic of townettings over the Atlantic slope, occurring frequently from the surface to 1,000 fathoms though never very plentiful.

Spinocalanus spinosus, sp. n.

Pl. I, fig. 10.

Female—length 1·9 mm.

Cephalothorax of the same form as in *Spinocalanus abyssalis*, but slightly more robust. Lateral faces of thoracic segments (Pl. I, fig. 10), finely spinulose. Antennae, mouth parts, and swimming feet as in *S. abyssalis*. Genital swelling less prominent than in *S. abyssalis*, with which the abdomen agrees in other respects.

Male unknown.

This species may readily be distinguished from *S. abyssalis* by its slightly larger size and more robust form, and by the fine spinulation on the sides of the thoracic segments. It agrees in size with *S. latifrons*, but it seems unlikely that, if they are identical, Prof. G. O. Sars would have omitted to mention such a noticeable feature as the thoracic spinulation in his description.

Occurrence.—It was found in small numbers on five stations, at depths between 330 and 1,000 fathoms.

GENUS Pseudocalanus, Boeck.

Pseudocalanus elongatus (Boeck).

Occurrence.—Was only met with in small numbers. It is a distinctly epiplanktonic species, and is probably not usually associated with water of high salinity.

GENUS Microcalanus, G. O. Sars.

Microcalanus, sp.

A species of Microcalanus, length ·55 mm., occurred in small numbers on station S.R. 193, 630 fathoms (fine silk net), and S.R. 197, 680 fathoms (fine silk net). It bears a great resemblance to *Microcalanus pusillus* in general form, and probably should be referred to that species in spite of its smaller size. As, however, the antennae were broken, and the exopodites of the swimming feet, which bear the characteristic terminal spines were missing in all the specimens found, I have thought it best not to record it definitely.

GENUS Clausocalanus, Giesbrecht.

Clausocalanus arcuicornis (Dana).

Occurrence.—Only one specimen was met with in the tow-nettings we have dealt with, on station S.R. 164 (the most southerly station) at 200 fathoms.

This species seems to be an epiplanktonic southern form though it has occasionally been taken off the west coast of Ireland, and has been recorded at intervals from the English Channel during the course of the International Investigations.

GENUS Ctenocalanus, Giesbrecht.

Ctenocalanus vanus, Giesbrecht.

Occurrence.—Seems to be generally distributed in the N.E. Atlantic, from the surface to 1,000 fathoms, but is always taken in very small numbers.

GENUS Aetideus, Brady.

Aetideus armatus (Boeck).

Pseudocalanus armatus, Boeck, 1872.

Aetideus armatus, Brady, 1883.

Aetideus tenuirostris, Wolfenden, 1902.

Occurrence.—This species is widely distributed off the west coast of Ireland from the surface to 1,000 fathoms, and is often moderately common.

Aetideus Giesbrechti, Cleve.

Aetideus armatus, Giesbrecht, 1892.

Aetideus Giesbrechti, Cleve, 1904.

Aetideus Giesbrechti, G. O. Sars, 1905.

Occurrence.—Represented by a single specimen from 200 fathoms on station S.R. 164 (the most southerly station).

This should probably be regarded as a southern species and not as a permanent inhabitant of these waters. The recorded distribution is the central Pacific, off Gibraltar, the Mediterranean, and South Africa.

GENUS Faroella, Wolfenden.

Faroella multiserrata (Wolfenden).

Pseudaetideus multiserrata, Wolfenden, 1903, nom. nud.

Faroella multiserrata, Wolfenden, 1904.

Aetideopsis multiserrata, G. O. Sars, 1907.

Being in doubt as to the correctness of my identification of this species, I submitted specimens both to Dr. Wolfenden and Prof. G. O. Sars. The latter wrote that they were quite distinct from his *Aetideopsis rostrata*, while Dr. Wolfenden informs me that, except for a rather coarser serration of the terminal spines of the swimming feet (*ca.* 32 serrations on the spines of the second feet in my specimens), and a slightly more prominent rostrum (probably due to different methods of preservation), they are in agreement with his Färöe Channel specimens. I have accordingly recorded them under the name given by him.

The main points of difference between *Faroella* and *Aetideopsis* are apparently the much more prominent rostrum and separate fifth thoracic segment possessed by the latter. Sars regards them as being congeneric.

The integument of this species, like that of *Chiridius armatus*, is dotted with minute asperities, and the general resemblance between it and the members of the genus *Chiridius* is so marked that it raises a doubt as to whether it is right to separate it from them.

Occurrence.—*Faroella multiserrata* is a distinctly deep-water species, occurring not uncommonly from 400 to 1,000 fathoms. It was found on six out of the eight stations and in thirteen gatherings. It was absent from S.R. 164, the most southerly station, probably on account of insufficient depth.

GENUS **Chiridius**, Giesbrecht.

Chiridius armatus (Boeck).

Euchaeta armata, Boeck., 1872.

Chiridius armatus, G. O. Sars, 1903, nec. 1900.

Pseudaetidius armatus, Wolfenden, 1903, 1904.

I have here followed Prof. G. O. Sars in his re-definition of Giesbrecht's genus *Chiridius* (as distinct from *Gaidius*) so as to include the above species, since the presence or absence of a rostrum does not seem to be sufficient to separate generically species which in other respects minutely resemble each other. The fact that Giesbrecht originally defined the genus as not having a rostrum should not in itself have any weight.

Amongst the numerous specimens of *C. armatus* examined one female was found with a single rostrum. It was identical in size and in all its parts, except that mentioned, with the rest, and as no second specimen has been found there seems to be no reason for regarding it as anything but a case of individual variation.

Occurrence.—*C. armatus* occurred on all the stations except S.R. 164, and at all depths between 280 and 1,000 fathoms, being rather more numerous at about 750 fathoms.

Chiridius gracilis, sp. n.

Chiridius Poppei, Farran, 1905.

Pl. II, figs. 1-3.

Female—length 2·4–2·8 mm.

Cephalothorax oblong-ovate, of the same form as in *Chiridius armatus*. Cephalon fused with first thoracic segment, rostrum absent. Fourth and fifth thoracic segments fused, the latter produced into a strong point on either side, as in *C. armatus*.

Abdomen contained about two and a half times in the length of the cephalothorax. Genital segment about two-thirds as long as the two following segments taken together. The proportional lengths of the abdominal segments are 21 : 16 : 14 : 11. Furcal rami about one and a half times as long as broad, and equal in length to the anal segment. Furcal setae slender.

First antenna reaches to about the end of the cephalothorax the proportionate length of the joints being approximately as in *C. armatus*, joints 8-9 fused and 24-25 separate.

Second antennae and mandible as in *C. armatus*.

Maxilla of the same type as in *C. armatus*, but with the second basal more elongate and parallel sided.

First and second maxillipedes as in *C. armatus*.

First foot as in *C. armatus*.

Second foot (Pl. II, fig. 3) with three-jointed exopodite; the first and second joints are however partially fused, and the muscle

for moving the second joint absent (as is also the case in *C. armatus*, though in that species the joints appear to be completely separate). The endopodite of the second foot has its two joints almost completely fused, the segmentation being only indicated by a faint line.

Third foot with three-jointed exopodite and imperfectly three-jointed endopodite, the segmentation between the first and second joints not being complete.

Fourth foot much more slender than the third, but resembling it in jointing, except that the segmentation of the endopodite is complete. The terminal spines of the second to fourth feet are coarsely serrate as in *C. armatus*.

Fifth feet absent.

Male unknown.

This species was formerly recorded by me (1905) as a large form of *C. Poppei*, but I have thought it best to describe it as a new species. It stands in size midway between *C. obtusifrons* from the Norwegian Sea, and *C. Poppei* from the Mediterranean, both of which, like it, have no rostrum. *C. obtusifrons* is almost twice its size, and has undergone a greater reduction in the jointing of the swimming feet, the endopodite of the second foot being without a trace of segmentation, and the first and second basal joints of the endopodites of the third and fourth feet almost completely fused. It also differs in having the points of the fifth thoracic segments somewhat shorter.

C. Poppei, on the other hand, is very much smaller (1·8 mm.), and may also be separated by its shorter abdomen and more robust form, though agreeing in the jointing of the swimming feet.

Occurrence.—*C. gracilis* was taken on every station but S.R. 164, and in twelve out of thirty-four gatherings, generally a few specimens in each. Its range was from 280 to 1,000 fathoms.

Genus **Pseudeuchaeta**, G. O. Sars.

Pseudeuchaeta brevicauda, G. O. Sars.

I have ventured to differ from Prof. G. O. Sars in removing this species from the neighbourhood of *Euchaeta*, as it seems to me that the apparent resemblance to that genus is only superficial, and that the genus *Pseudeuchaeta* is in reality closely allied to *Bradyidius*, *Bradyetes*, and *Bryaxis*. The first antenna is noticeably of the same type as in *Bradyidius*, the profuse setae and the large separate terminal joint being very characteristic. The mouth appendages, except the second maxillipede, are of a form common to many of the Aetidiidae, but differ from those of *Euchaeta*, especially as regards the maxilla. The second maxillipede, which at first sight appears to resemble that of *Euchaeta*, differs in the position of the median setae of the second joint which are placed nearer the proximal than the distal end. The jointing of the swimming feet agrees much more closely with the Aetidiidae than with *Euchaeta*, and the appendicular seta of the furca, which in *Euchaeta* is remarkable for its length, is in this species very short.

I am indebted to Prof. G. O. Sars for kindly confirming my identification of this species from drawings which I sent to him.

Occurrence.—Taken on stations S.R. 224, three specimens, females, at 700 fathoms, and S.R. 231, one female, at 1,150 fathoms.

GENUS **Gaidius**, Giesbrecht.

Gaidius tenuispinus (G. O. Sars).

Chiridius tenuispinus, G. O. Sars, 1900.

Gaidius boreale, Wolfenden, 1902.

Gaidius tenuispinus, G. O. Sars, 1903.

Occurrence.—On all stations except S.R. 164, and ranging from the surface to 1,000 fathoms. It was found in seventeen out of thirty-four gatherings, and may be regarded as a permanent and characteristic member of the fauna of the district.

Gaidius affinis (G. O. Sars).

Gaidius affinis, G. O. Sars, 1905.

Pl. II, figs. 9-10.

Some specimens of this species were submitted to Prof. G. O. Sars who kindly confirmed the identification. They are rather larger than the typical *G. affinis*, measuring from 3·9 to 4·5 mm. instead of 3·6 mm. *G. affinis* resembles very closely *G. intermedius* of Wolfenden from the Antarctic, and is only to be distinguished from *G. brevispinus*, with which its swimming feet agree, by its smaller size and the longer and more slender spines on the fifth thoracic segment directed obliquely posteriorly.

Occurrence.—This species was taken on three stations at depths from 700 to 1,150 fathoms, very few specimens, all females, being found.

Gaidius validus, sp. n.

Pl. II, figs. 11-17.

Female—Immature, length 6·2 mm.

The only specimen obtained of the above was an immature female, but as it appeared to have reached the full development of its limbs and mouth parts I have described and named it.

Cephalothorax elongate, parallel-sided, noticeably contracted in dorsal view in front of the second antennae, and more pointed anteriorly than in the other members of the genus. Cephalon fused with the first thoracic segment and more than twice as long as the remaining thoracic segments. Fourth and fifth thoracic segments (Pl. II, fig. 11) fused and bearing on either side a strong spine which springs from the lateral margin. These segments resemble in dorsal view those of *Centropages typicus*, but the spines are not divergent as in that species.

Abdomen measuring about one-fourth of the cephalothorax, with four equal segments (immature segmentation). Furcal rami divergent, about as long as broad.

First antenna a little longer than the body, 24-jointed, joints 8-9 being fused and 24-25 separate. The proportionate length of the joints is approximately as in *G. affinis* and *G. brevispinus*.

Second antenna (Pl. II, fig. 12) with endopodite measuring about two-thirds of exopodite. First joint of the exopodite with a small distal seta, second joint with two setiferous lobules on the proximal half of the joint and a small distal seta, third to sixth joints each with a long distal seta, seventh joint with a small median and three large distal setae.

Mandible as in the rest of the genus.

Maxilla (Pl. II, fig. 14) with the second and third inner lobes very long, second basal joint large with parallel sides and six distal setae, endopodite with about sixteen setae, exopodite small oval with ten setae, outer lobe with seven long setae and two short curved proximal setae.

First maxillipede as in *Gaetanus*, with a strong curved spine on the fourth and fifth lobes.

The second maxillipede (Pl. II, fig. 13) is of the *Gaetanus* type. The terminal spine on the inner margin of the second joint is very much reduced, and the sensory lobe on the outer margin very prominent.

First foot (Pl. II, fig. 15) having a three-jointed exopodite with a spine on the outer margin of each joint. The segmentation between the first and second joints is not complete (possibly an immature character).

Second foot (Pl. II, fig. 16) with three-jointed exopodite and imperfectly two-jointed endopodite.

Third and fourth feet with three-jointed exopodites and endopodites. The terminal spines of the endopodite of the second to fourth feet are coarsely serrate. The first basal joint of the fourth foot does not bear any well-marked spines, but the setae on its margin are straight and noticeably shorter and stiffer than those of the third foot.

Fifth feet absent.

Male unknown.

This species appears to be distinct from *G. divaricatus*, which, if I rightly interpret Prof. G. O. Sars' description, is separated from it not only by its much smaller size (4·25 mm.), but also by having the fifth segment of the thorax distinct from the fourth and the lateral thoracic spines divergent.

Occurrence.—One specimen was taken on station S.R. 231, 1,150 fathoms.

Gaidius notacanthus, G. O. Sars.

Pl. III, fig. 7.

All the females captured of this species were immature, but the presence of three mature males enables me to give a figure of the fifth pair of feet which, while of the same type as those of

G. tenuispinus, have the second and third joints of the exopodite of the left foot much shortened, bearing lamellae and fringed with fine setae. The maxilla and first maxillipede in the male are, as usual, reduced, and the outer-edge spine of the first joint of the exopodite of the first foot is only represented by a very small tooth. Prof. G. O. Sars has kindly identified some specimens of this species which I sent to him.

Occurrence.—A few specimens were taken on four stations from depths of 600 to 1,150 fathoms.

Gaidius parvispinus, sp. n.

(Pl. II, figs. 4-8).

Female—immature, length 4·9 mm.

Cephalothorax of the usual *Gaidius* form, but with the fourth and fifth thoracic segments separated, as in *G. notacanthus*. The fifth segment (Pl. II, fig. 5) bears on its postero-lateral margin a very short, ventrally directed, hooked spine. Rostrum single, short, stout. Abdomen of four segments (immature segmentation).

The first antenna is 23-jointed, the proportional length of the joints being very much as in *G. tenuispinus*.

The second antenna agrees better with that of the genus *Chiridius* than *Gaidius*, the first joint of the endopodite being short and stout, about equal in length to the second joint of the exopodite. The arrangement of setae is as usual.

The mandible palp is as in *Chiridius*. The cutting edge was not examined.

The maxilla is of the same form as in *Chiridius*, but the outer lobe is very small though bearing the usual ten setae.

The first maxillipede is as in *Chiridius*. The tips of the second to fourth lobes are crowded with minute acicular spinules.

The second maxillipede (Pl. II, fig. 8) is of the *Chiridius* type, but the first joint is somewhat shorter. The proportional lengths of the first, second, and third to seventh joints are approximately 2 : 3 : 1. The first joint, as in *Chiridius*, has no lobule on its lower edge.

The first foot (Pl. II, fig. 6) has an imperfectly three jointed exopodite, the first joint being partially fused with the second, and bearing an outer-edge spine at the distal margin reaching to the base of the outer-edge spine of the second joint. The endopodite is broad and rounded.

The second foot (Pl. II, fig. 7) has a three-jointed exopodite, but the articulation between the first and second joints is incomplete. The terminal spine of the third joint is very finely serrulate. The endopodite is one-jointed, but with a faint transverse line marking the fusion of the two original joints.

The third and fourth feet have three-jointed exopodites and endopodites, the segmentation between the first and second joints of the endopodites being not complete, possibly an immature characteristic. The outer edges of the basipodites are smooth.

The fifth pair of feet are undeveloped, and consist on either side of two basal joints and a finger-and-thumb like exopodite and endopodite.

Male unknown.

I regard this immature form as being of undifferentiated sex which, for purposes of comparison, may be regarded as female, even though an undeveloped fifth pair of legs are present.

The limbs and appendages are practically identical, except for their smaller size, with those of *G. notacanthus*, and differ from those of *G. affinis*, *G. brevispinus*, *G. tenuispinus*, and *G. pungens* in their more robust form, in the stouter endopodite of the second antenna, in the absence of a lobule on the first joint of the second maxillipede, in the presence of an outer-edge spine on the first joint of the exopodite of the first foot, and in the finer serration of the terminal spines of all the swimming feet.

There is no doubt that both *G. notacanthus* and *G. parvispinus* should be separated generically from *Gaidius*, but no harm can be done by leaving them in that genus, as G. O. Sars has done, until mature females of one or both of them have been met with.

I would have been inclined to ascribe this species to *G. cryptospinus* if it were not that in that species the endopodite of the second foot is distinctly two-jointed, and the lateral spines of the fifth thoracic segment are described as nodiform protuberances, a description which does not accurately designate the lateral spines of *G. parvispinus*.

Occurrence.—On stations S.R. 175 and S.R. 197, between 580 and 680 fathoms.

GENUS **Gaetanus**, Giesbrecht.

Gaetanus pileatus, Farran.

Gaetanus pileatus, Farran, 1901.

Gaetanus caudani, G. O. Sars, 1905.

Gaetanus caudani, Wolfenden, 1904.

Gaetanus caudani, Pearson, 1906.

nec *Gaetanus caudani*, Canu, 1896.

This species has been recorded from the N.E. Atlantic by Dr. Wolfenden (1904) under the name of *G. caudani*, and Prof. G. O. Sars informs me that his record of *G. caudani* (1905) also refers to it. I do not think, however, that in the face of the discrepancies between this species and Canu's minute and carefully worded description that these identifications can be upheld. Canu states his specimen to have been an immature male with a rudimentary pair of fifth feet, but as far as I can ascertain no distinction can be drawn between males and females at this stage, as both sexes appear to possess rudimentary fifth feet

which are lost by the female in the final ecdysis, at any rate in this genus. In any case the immature specimens at the stage described by Cann agree with the matnre females in form of limbs and mouth parts, differing only in the jointing of the abdomen, so that doubt cannot be thrown on Cann's description on this account.

The first swimming foot in *G. pileatus* has a two-jointed exopodite, while in *G. caudani* the exopodite is three-jointed with outer-edge distal spines on each joint; to quote the original description—"La rame externe des pattes de la 1re paire est composée de trois articles, et semblable presque en tous points à la rame externe de la 1re patte de *G. armiger* (ajouter à celle-ci une épine au bord distal externe du 1er article de la rame externe, pour compléter l'organisation chez *G. caudani*)."

A further point of difference is to be found in the second antennae, the second joint of the exopodite of which in *G. caudani* bears two setiferous lobules on its inner margin, while in *G. pileatus* the margin of the joint is bare.

Occurrence.—This species is a very noticeable feature in the deep-water fauna off the west coast of Ireland, occurring, often in considerable numbers, in almost every townet from 200 to 1,150 fathoms.

Gaetanus miles, Giesbrecht.

Occurrence.—This species was found on three stations, viz., S.R. 197, 680 fathoms, S.R. 224, 700 fathoms, and S.R. 231, 400 fathoms, only single specimens on each occasion, so that it can hardly be regarded as a permanent inhabitant of these waters.

Gaetanus latifrons, G. O. Sars.

Gaetanus latifrons, G. O. Sars, 1905.

Gaetanus Holti, Farran, 1905.

Gaetanus longispinus, Wolfenden, 1905.

There can, I think, be no doubt as to the identity of *G. latifrons* and *G. longispinus*, and possibly both may prove to be synonyms of *G. caudani*.

Occurrence.—This species is a noticeable feature in N.E. Atlantic townettings, though not so common as *G. pileatus* or *G. major*. It was taken on every station at depths of from 330 to 1,150 fathoms.

Gaetanus major, Wolfenden.

Gaetanus major, Wolfenden, 1903.

? *Gaetanus Kruppi*, Giesbrecht, 1903.

G. Kruppi appears to be at most a rather smaller Mediterranean variety of this species, with a similar habitat.

Occurrence.—Occurred on every station and in almost every townetting from 300 to 1,150 fathoms. It is one of the most characteristic copepods that occur off the west coast of Ireland, though apparently never approaching the surface.

Gaetanus minor, Farran

Occurrence.—A not uncommon species off the west coast of Ireland, and not confined to such great depths as the records given in the table seem to show. Its small size will account for its apparent scarcity.

Genus Undeuchaeta, Giesbrecht.

Undeuchaeta major, Giesbrecht.

Chirundina angulata, G. O. Sars, 1905.

Occurrence.—On every station at depths of from 350 to 1,000 fathoms, and in sixteen out of the thirty-four gatherings, generally in moderate numbers.

Undeuchaeta minor, Giesbrecht.

Occurrence.—On every station, at depths of from 400 to 1,100 fathoms. It was only represented in eleven gatherings, but when it was present was usually more numerous than *U. major*.

Genus Chirundina, Giesbrecht.

Chirundina Streetsi, Giesbrecht.

Euchirella carinata, Wolfenden, 1902.

Occurrence.—This species is of frequent occurrence in the N.E. Atlantic, having been taken on every station at depths of from 300 to 1,000 fathoms.

Genus Euchirella, Giesbrecht.

Euchirella messinensis (Claus).

There does not appear to be any noticeable difference between the species as figured by Giesbrecht from the Mediterranean and as occurring in the N.E. Atlantic.

Occurrence.—Occurs frequently but not universally in deep water off our western coasts, having been taken on five stations at depths of from 350 to 700 fathoms.

Euchirella galeata, Giesbrecht.

Occurrence.—A few specimens were taken on five stations, at depths of from 350 to 700 fathoms.

Euchirella maxima, Wolfenden.

Euchirella maxima, Wolfenden, 1905.

Occurrence.—This very distinct and easily recognised species was taken on five stations at depths of from 350 to 1,000 fathoms.

It seems probable that this and the two preceding species are permanent inhabitants, though not in large numbers, of the deep water off the Irish coast.

Euchirella curticauda, Giesbrecht.

I have not met with any mature specimens which could be referred to Wolfenden's *E. atlantica*, but a few immature specimens measuring about 6·2 mm., and closely resembling *E. curticauda* in form, may possibly belong to it. In my specimens of *E. curticauda* the size varied from 4·3 to 4·8 mm., and the number of spines on the basal joint of the fourth foot from nine to twelve, but no definite distinction between the N.E. Atlantic and the typical form could be made out.

Occurrence.—This species is of frequent occurrence and often moderately common. It was taken on every station at depths of from 200 to 1,000 fathoms, and in eighteen out of thirty-four gatherings. It has on other occasions been taken at the surface.

Euchirella rostrata (Claus).

Occurrence.—This species was met with on two stations, viz., S.R. 224, when a considerable number of specimens was taken at 700 fathoms, and S.R. 231, when it occurred in small numbers in the nets at 200, 400, 750, and 1,000 fathoms. It is known to be a species of epiplanktonic habits and wide distribution in European waters, so that it should probably not be regarded as a permanent member of the N.E. Atlantic deep-water fauna. The specimens met with varied in size from 3·3 mm. to 4·2 mm.

Euchirella Wolfendeni, sp. n.

Pl. II, figs. 18-19.

Pl. IV, fig. 3.

Female (Pl. IV, fig. 3)—length 7·4 mm.

Cephalothorax ovate, robust. Cephalon fused with first thoracic segment, but the line of segmentation visible, without crest, and very slightly vaulted. Rostrum of moderate length. Fourth and fifth thoracic segments separate, the latter contracted posteriorly, and with rounded lateral margins.

Abdomen about one fourth as long as the cephalothorax. Genital segment about as long as broad, asymmetrical, not swollen below, with a projecting lobule on the right side and a low tubercle on the left. Second segment about as broad as long,

rather longer than third, and twice as long as the anal segment. Furcal rami about as broad as long, divergent, with setae of moderate length.

First antenna as long as the whole body.

Second antenna (Pl. II, fig. 18) with endopodite rather more than half as long as exopodite, and bearing 7+8 setae.

Mandible with strongly toothed cutting edge and slender unbranched palp, second joint of basipodite of mandible without setae, first joint of exopodite short, without setae, second joint long, with small median seta, third and fourth joints each with a long distal seta, fifth joint with two long setae.

Maxilla of the same general form as in *E. rostrata*, the exopodite being very small, but the setae are much more numerous than in that species. Second inner lobe with five strong setae, third inner lobe with four more slender setae, second basal with five, and endopodite with at least sixteen setae. Exopodite with eleven and outer lobe with seven large and one small setae.

First and second maxillipedes of the same general form as in *E. rostrata*.

First foot with three-jointed exopodite, the first and second joints not being completely separated, each joint bearing a distal outer-edge seta, that on the first joint being rather slender but reaching beyond the extremity of the second joint. The endopodite is one-jointed, broad and oval, with a well marked shoulder.

Second foot with a three-jointed exopodite and one-jointed endopodite.

Third and fourth feet each with three-jointed exopodites and endopodites. The first basal joint of the fourth foot (Pl. II, fig. 19) bears a transverse row of seven short strong equal spines on a process projecting from its inner margin.

The terminal spines of the second to fourth feet are rather finely serrate, that of the second foot having about sixty serrations.

Fifth feet absent.

Male unknown.

If we compare this species with the other known non-cristate rostrate females of the genus *Euchirella*, viz., *E. messinensis*, *E. bella*, *E. venusta*, *E. brevis*, *E. rostrata*, *E. hirsuta*, *E. elongata*, and *E. spinosa*, we may separate the first four as having four or less spines on the fourth foot basal. Of the remainder, *E. hirsuta* and *E. spinosa* have fourteen basal spines on the fourth foot, while *E. rostrata* may be separated by its very long rostrum and much more globose cephalon, and *E. elongata*, which approaches *E. Wolfendeni* most nearly, by the pointed lateral margins of the fifth thoracic segment. *E. Wolfendeni* may perhaps turn out to be a synonym of *Undeuchaeta pustulifera*, but Sars' description of that species is not sufficient to decide the point with certainty.

Occurrence.—This species was taken on two stations, viz.:—S.R. 224, five specimens at 700 fathoms, and S.R. 231, three specimens at 1,000 fathoms. It is impossible from these records to say whether it is a permanent inhabitant or a chance visitor but the former seems to be the more probable.

Euchirella obtusa (G. O. Sars).

Undeuchaeta obtusa, G. O. Sars, 1905.

Pl. II, figs. 20–21.

Pl. IV, fig. 2.

I have included this species under the genus *Euchirella* rather than under that in which it was originally placed by Prof. G. O. Sars, as it does not appear to me to be congeneric with *Undeuchaeta major* and *U. minor*. The published description, as far as it goes, agrees exactly with my specimens.

Occurrence.—Five specimens in all were taken on three separate stations; one on S.R. 197 at 680 fathoms, one on S.R. 224 at 700 fathoms, and three on S.R. 231 at 1,000 fathoms. It may consequently be considered as a permanent, though rather scarce member, of the N.E. Atlantic skoto-plankton.

Genus Euchaeta, Philippi.

Euchaeta acuta, Giesbrecht.

Occurrence.—Not characteristic of the N.E. Atlantic skoto-plankton, though a few specimens have been taken in deep water. Two females, measuring 4·4 mm., were taken at 700 fathoms on station S.R. 224, and eleven females, two of them ovigerous, at 350 fathoms on station S.R. 164. A single male, most probably of this species, was found on station S.R. 175 at 600 fathoms.

Euchaeta norvegica, Boeck.

E. norvegica has not been noticed to vary in size except within very small limits, the average length of the N.E. Atlantic examples being 7 mm., and it seems probable that the dimensions 7-15 mm. given by Giesbrecht (1898) in the "Tierreich" are founded on incorrect identifications by other authors.

Occurrence.—This species is one of the most noticeable features of the deep-water fauna off the west coast of Ireland. It usually forms at least half the copepod contents in bulk of any coarse silk or other similarly meshed net, fished between 300 and 1,000 fathoms, and is occasionally taken in an immature state at or near the surface.

Euchaeta barbata, Brady.

Euchaeta barbata, Brady, 1883.

Pl. III, figs. 13–14.

In the material taken by the *Helga*, and here dealt with, there occurred in small numbers three species of *Euchaeta*, all closely allied, and all agreeing in form with the original description of

E. barbata, but clearly differing from each other in size and colour, and in a few minute structural points. In this difficulty it seemed to me that the species agreeing most nearly in size with the type specimen would have the best claim to the name given by Brady. I have accordingly applied the name to the species of medium size, which measures from 8·1–8·8 mm., Brady's original specimen measuring 8·4 mm.

In colour this species is of a deep crimson, darker on the limbs and mouth parts and on the edges of the body segments, thus differing from both the larger and smaller forms, which are not so deeply coloured and have a vermilion tinge. It is further separated from them by the presence of a small tubercle on the left side of the genital segment, situated slightly posterior to the genital opening. (Pl. III, fig. 13).

An examination of Brady's type specimen in the British Museum did not throw much light on the question, as the single specimen had been mounted, and the balsam in the slide having partially dried up, it was impossible to see whether the lateral tubercle on the genital segment were present or not.

Occurrence.—*Euchaeta barbata*, as defined above, occurred in small numbers on five stations at depths of from 700 to 1,000 fathoms.

Euchaeta Sarsi, sp. n.

?*Euchaeta barbata*, G. O. Sars, 1903.

Euchaeta barbata, Wolfenden, 1904.

? *Euchaeta porrecta*, G. O. Sars, 1905.

Pl. III, figs. 15-16.

Female—length 9·810·2 mm.

Colour, body with a faint reddish tinge, the mouth parts of a bright red, particularly on the maxillipede spines, the swimming feet similarly coloured but less deeply.

Form of the body as in *E. barbata*, the posterior lateral margins of the last thoracic segment rounded and bearing a thin bunch of long hairs. Epistome densely hirsute.

First three abdominal segments in the proportion 11 : 6 : 6. Genital segment (Pl. III, fig. 15) resembles that of *E. barbata*, except that the small sinistral tubercle is absent. The ventral surface of the second and third abdominal segments is very setose, and the dorsal surface of the third segment bears a few scattered short hairs. The first, third, and fourth furcal setae (from within) are approximately of equal length, the second seta is very long, and the appendicular seta extremely long and slender, the proportional lengths being 1 : 3 : 7. The antennae and mouth parts resemble those of *E. barbata*; the second maxillipede seems, however, to be rather more slender.

The first foot has the outer-edge seta at the fusion of the first and second joints extremely minute, the segmentation between the joints being very faintly indicated. In the exopodite of the

second foot (Pl. III, fig. 16), the sinus between the second and third outer-edge spines of the third joint is not so deep as in *E. barbata*. It falls short of the line joining the bases of the first outer-edge spine and the second inner-edge seta. The second outer-edge spine is much shorter than in *E. barbata*. The remaining feet are of the same type as in *E. barbata*, and do not call for remark.

Male unknown.

This species is undoubtedly the *E. barbata* of Wolfenden, and possibly also that of G. O. Sars (1903), although the size given by the latter (12·0 mm.) is rather larger, and the proportionate lengths of the furcal setae not quite the same. The figure of the genital segment is also slightly different.

Occurrence.—A few specimens were taken on three stations, viz. :—S.R. 139, 1,000 fathoms, S.R. 224, 700 fathoms, and S.R. 231, 1,000 fathoms.

Euchaeta Scotti, sp. n.

Pl. III, figs. 11-12.

Female—length 5·7–6·3 mm.

Colour of body reddish, rather more deeply coloured than in *E. Sarsi*. Legs and mouth parts vermilion.

Form of the body as in *E. barbata*; the cephalothorax seems however to be somewhat more robust. Epistome hirsute. The bunch of hairs on the fifth thoracic segment well developed.

Lengths of the first three abdominal segments in the proportion 11 : 6 : 6. The genital segment (Pl. III, fig. 11) is of the same form as in *E. barbata*, except that the small sinistral tubercle is absent. The ventral surface of the second and third abdominal segments is setose, their dorsal surface being covered more sparingly with much shorter hairs. The first, third, and fourth furcal setae, reckoning from within, are approximately equal, the second slightly longer, and the appendicular seta very long, the proportional lengths being 5 : 7 : 16.

Antennae and mouth parts as in *E. barbata*.

In the first pair of feet the outer-edge seta at the fusion of the first and second joints of the exopodite is very minute, and can with difficulty be observed. The fusion of the joints is very complete, the suture being barely indicated.

In the exopodite of the second pair of feet (Pl. III, fig. 12), the sinus between the second and third outer-edge spines of the third joint is not so deep as in *E. barbata*. The second outer-edge spine in the same joint is much smaller than in *E. barbata*, falling far short of the base of the third outer-edge spine. There is no noticeable difference between the remaining feet and those of *E. barbata*.

Male unknown.

Occurrence.—This species was taken on the same five stations as *E. barbata* at depths of from 700 to 1,000 fathoms, but very few specimens were found on each occasion.

Euchaeta quadrata, sp. n.

Euchaeta barbata, Scott.

Pl. III, figs. 20-21.

Female—length 6·9 mm.

Body colourless, second maxillipede reddish purple, especially on the setae.

Cephalothorax similar in shape to that of *E. norvegica*, except that the fifth thoracic segment is rounded laterally and bears a marginal patch of hairs. Rostrum more slender than in *E. norvegica*.

Abdomen half as long as the cephalothorax, its first three segments being in the proportion 5 : 4 : 3. Genital segment (Pl. III, fig. 20) with a parallel-sided almost quadrate projection from the centre of its ventral face, equal in height to the diameter of the segment, and at right angles to it. Second and third abdominal segments without hairs. Furca slightly hirsute. First, third, and fifth furcal setae (counting from within) of about equal length. Second seta twice as long as first. Appendicular seta very long, broken in my specimens.

The first antennae reach, when extended, to the middle of the genital segment.

Second antennae as in *E. norvegica*; terminal setae of endopodite 8+6; mandible as in *E. norvegica*.

Maxilla with nine setae on the outer lobe, eleven on the exopodite, and about thirteen on the endopodite.

First maxillipede as in *E. norvegica*. Second maxillipede of the same form as in *E. norvegica*, but the distal part of the inner edge of the second joint is very finely setose and the setae on the third to seventh joints rather more slender.

First foot in form as in *E. norvegica*, but the outer-edge seta at the fusion of the first and second joints is very minute.

Second foot (Pl. III, fig. 21) with the second outer-edge spine of the third joint of the exopodite reaching to the end of the joint.

Third and fourth feet as in *E. norvegica*.

Fifth feet absent.

Male unknown.

This species is easily recognised by its very large protruding genital swelling, which appears almost square in lateral view. It has been recorded by Dr. T. Scott from the Gulf of Guinea, as an examination of the specimens in the British Museum shows under the name of *E. barbata*.

Occurrence.—This species seems to be a fairly constant feature of the N.E. Atlantic fauna, though not descending to such depths as some of the other *Euchaetae*. It was taken in small numbers on five stations at from 350 to 700 fathoms.

Euchaeta rubicunda, sp. n.

Pl. III, figs. 8–10.

Female—length 8·8 mm.

Colour of a bright reddish crimson, darker on the margins of the body segments.

Cephalothorax of the *E. norvegica* type, but with rounded setiferous postero-lateral margins to the fifth thoracic segment. Rostrum slightly shorter than in *E. norvegica.*

Abdomen short, being contained about two and half times in the length of the cephalothorax. Genital segment (Pl. III, figs. 8–9) equal in length to the two following segments taken together. The genital process is large, the genital opening being flanked by a pair of lateral plates of the *E. barbata* type, but more swollen and connected posteriorly at their base. Within these plates are a pair of small tubercular processes. The posterior face of the genital process is inflated. There is a low longitudinal chitinous ridge running dorsally along the anterior half of the left side of the genital segment. The second and third abdominal segments are of equal length and setose on their ventral and lateral faces.

The first, third, and fourth furcal setae (counting from within) are of equal length, the second twice as long, and the appendicular seta four times as long as the first.

The first antenna reaches, when extended, to the base of the fourth pair of feet.

Second antenna and mandible as in *E. norvegica.*

Maxilla with five setae on the outer lobe, ten on the exopodite, and nine on the endopodite

First and second maxillipedes as in *E. norvegica.*

First foot, with the segmentation between the first and second joints of the exopodite rather more plainly indicated than in *E. norvegica.* The outer margin of the fused joints is deeply hollowed, and the first outer seta very minute.

Second foot (Pl. III, fig. 10) with the sinus between the second and third outer-edge spines of the third joint of the exopodite very deep.

The second outer-edge spine reaches to the end of the joint.

Third and fourth feet as in *E. norvegica.*

Male unknown.

This species, like the three just described, is an addition to the *norvegica* section of *Euchaeta.*

Occurrence.—One specimen from 1,150 fathoms on station S.R. 231.

Euchaeta tonsa, Giesbrecht.

Occurrence.—This is a rather characteristic species in deep water townettings ranging from 400 to 1,000 fathoms. It occurred on six stations, and in thirteen out of the thirty-four gatherings. The N.E. Atlantic form appears to be identical with that described by Giesbrecht from the Pacific.

Euchaeta bisinuata, G. O. Sars.

Euchaeta bisinuata, G. O. Sars, 1907.

Pl. III, figs. 17–19.

Pl. IV, fig. 4.

Professor G. O. Sars describes the genital protuberance of the female of this species as being divided into three lobules, of which the most anterior is double. I have figured the arrangement (Pl. III, fig. 17) as shown in all the specimens which I have examined, in which both of the anterior lobules are paired. With this exception the Irish specimens agreed closely in size and structure with the description of the type, and I have no doubt that they are identical.

Occurrence.—Taken in small numbers on three stations at depths beween 700 and 1,150 fathoms.

GENUS Valdiviella, Steuer.

Valdiviella insignis, sp. n.

Pl. III, figs. 1-6; Pl. IV, fig. 5.

Female (Pl. III, fig. 1)—length 11·5–12·0 mm.

Cephalothorax robust, ovate, of the same form as in *Euchaeta*. Cephalon fused with first thoracic segment. Fourth and fifth thoracic segments fused, the latter with postero-lateral margin rounded. Rostrum of two sharp strong points.

Abdomen rather less than half the length of the cephalothorax, of four segments, their proportional lengths, with the furca, being about 5 : 4 : 3 : 1 : 1. Genital segment moderately swollen below and in dorsal view. Second and third segments with tufts of hair on their ventral surface, and denticulated dorsally on their posterior margin. Furcal rami oval, rather longer than wide, separated by more than their own width. First, third, and fourth furcal setae (counting from within) of about equal length, second seta about one and two-third times as long, and appendicular seta about two-thirds as long. The length of the innermost seta is equal to that of the second and third abdominal segments taken together. Egg sacs two, oval, with numerous ova.

The first antenna reaches to the end of the thorax.

Length of joints in ·01 mm.

1.	2.	3.	4.	5.	6.	7.	8-9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24-25.
35.	30.	27.	30.	36.	36.	27.	36.	12.	14.	12.	21.	24.	44.	63.	72.	63.	69.	60.	50.	45.	42.	45.

These measurements differ from those of *V. oligarthra* in the proportionately greater length of the more distal joints. The end joint is proportionately shorter than in that species.

Second antenna with one seta on the second basal joint. The inner lobe of the terminal joint of the endopodite bears two setae, the outer lobe six large and one small setae.

The mandible appears to be the same as in *V. oligarthra*.

Maxilla (Pl. IV, fig. 5) with seven setae on the outer lobe, the median one much the largest. The exopodite bears eleven setae, the endopodite three, and the second basal joint three. The first inner lobe has eleven setae, the second and third lobes four setae between them; they are superposed and possibly fused.

The first maxillipede (Pl. III, fig. 4) with three setae on each of the five lobes, the terminal seta on the fifth lobe being much stronger than the rest. The terminal joints of the maxillipede bear six comparatively long setae.

Second maxillipede with joints of the same proportionate length as in *V. oligarthra*, the first joint being two-thirds as long as the second and twice as long as the terminal joints. The first lobe bears one, the second two, the third one or more, and the fourth three setae.

First foot (Pl. III, fig. 6), as in *V. oligarthra*, the exopodite being two-jointed and the endopodite one-jointed.

The second foot (Pl. III, fig. 2) differs from that of *V. oligarthra* in having the exopodite imperfectly three-jointed, the segmentation between the first and second joints being faintly indicated, but the outer-edge spine at the end of the first joint fully developed, not rudimentary as in *V. oligarthra*.

The third foot (Pl. III, fig. 5) has an imperfectly three-jointed exopodite, the articulation between the first and second joints being plainly indicated though not functional. The endopodite has only a very faint indication of segmentation between the first and second joints.

Fifth feet absent.

Colour, a bright red, deepest on the limbs and mouth parts. Egg sacs orange.

Male unknown.

Of the two other known species of this genus, one, *V. brevicornis*, is only about half as long as the present species; the other, *V. oligarthra*, while nearly agreeing with it in size, may be separated by its shorter first antennae and the different form of the second pair of feet.

Occurrence.—Three specimens of this species were taken at depths of 700, 730, and 1,150 fathoms.

Genus **Chiridiella.**

Chiridiella macrodactyla, G. O. Sars.

Chiridiella macrodactyla, G. O. Sars.

Pl. IV, figs. 6–14.

The original description of *C. macrodactyla* differs in some few points from my specimens, but the differences are mainly those of proportion and not of structure, and do not warrant a

separate description. The abdomen in the *Helga* specimens is scarcely more than one-fifth of the length of the cephalothorax. Thesegmentation between the cephalon and first thoracic segment is indicated but not complete. The first antenna is almost as long as the whole body, and the exopodite of the first foot is more than twice as long as the endopodite.

The very strangely modified claw-like structure of the first maxillipede (Pl. IV, fig. 14) agrees with that of Sars' specimens, and from its occurrence in the female is probably due either to a predatory or semi-parasitic mode of existence. The reduction of the first pair of swimming feet would seem to point to the latter conclusion, though the presence of the species free in townettings is against it.

The absence of an inner-edge seta on the second basal joint of the first foot (Pl. IV, fig 6) is noteworthy, and, as far as I know, is not found in any other instance among the Amphaskandria.

Occurrence.—Single specimens were taken on stations S.R 175 at 600 fathoms, and S.R. 193 at 630 fathoms.

Genus **Phaenna.**

Phaenna spinifera, Claus.

Occurrence.—This species is only sparingly represented in the collection. It was found on station S.R. 164, one specimen at 100 fathoms and two at 350 fathoms, and on station S.R. 175, two specimens at 600 fathoms. The deep-water records may perhaps be accounted for by supposing the captures to have been made during the ascent of the net, as previous records of this species would lead to the belief that it is of epiplanktonic habits.

Genus **Xanthocalanus**, Giesbrecht.

Xanthocalanus typicus (T. Scott).

Amallophora typica, T. Scott, 1894.

Xanthocalanus typicus, Giesbrecht, 1898.

Pl. IV, figs. 15-17.

The species has up to the present only been known by Dr. T. Scott's (1894) description of the male from the Gulf of Guinea. The female shows, equally with the male, the curious sensory appendage formed by the enlargement of one of the terminal sensory setae of the first maxillipede (Pl. IV, fig. 16), which has the form of a sheaf of corn, and gave rise to the generic name *Amallophora* or sheaf bearer, of which this species was constituted the type by Scott. The species has since been removed by Giesbrecht (1898) to the genus *Xanthocalanus*, and his judgment in this respect is partly confirmed by the present specimen, the fifth feet of which are somewhat of the *Xanthocalanus* type, consisting of three short equal joints, the last joint with a pair of terminal diverging spines. The first foot (Pl. IV, fig. 17) appears at first sight to

have a two-jointed endopodite, but closer examination shows that the apparent segmentation is in reality a ridge running across the face of the joint.

The generic name *Amallophora* has been revived by Sars for a section of the genus *Scolecithrix*, one member of which, *Amallophora magna*, was included by Scott in the genus *Amallophora*, though not congeneric with the type species *A. typica*. This use of the name cannot be upheld, as the name should properly stand as a synonym of the genus *Xanthocalanus*, unless it should become necessary at any time to revive it in favour of the present species, a contingency which does not seem impossible.

Occurrence.—A single specimen of the female of this species was taken on station S.R. 197 at 680 fathoms.

? Xanthocalanus pinguis, Farran.

Pl. IV, fig. 18.

In view of the difficulty of deciding how far small differences met with in a single specimen should be regarded as constant or as individual variation, I have some hesitation in referring to *X. pinguis* the specimen whose capture is recorded below. The length of the specimen is 5·1 mm., which is slightly in excess of that of *X. pinguis*, viz., 4·5 mm. The form of the body is very similar, the fifth thoracic segment slightly more acute but swollen and full of oil drops. The mouth parts and swimming feet are similar. The fifth pair of foot (Pl. IV, fig. 18) are similar in form, but differ somewhat in spinulation; the first joint has about twenty short stout spinules in two rows along the inner edge, the outer edge being smooth; the second joint has about six inner-edge spinules similar to those on the first joint, the distal half of the outer edge bearing a cluster of lanceet-shaped spinules; there are a pair of lateral and a pair of terminal spines on the third joint as in *X. pinguis*, and the face of the joint bears a patch of slender spinules of two sizes near the tip.

Occurrence.—A single specimen taken on station S.R. 193 at a depth of 630 fathoms.

Xanthocalanus Greeni, Farran.

Xanthocalanus Greeni, Farran, 1905.

As Prof. G. O. Sars has recorded both *X. muticus* and *X. Greeni* from the Monaco collections, my suggestion that they were probably identical must be regarded as incorrect.

Occurrence.—This species is evidently a regular inhabitant of the deep water of the N.E. Atlantic, though not in great numbers. It occurred on three stations at depths of from 680 to 1,150 fathoms, nine specimens in all being taken, the largest measuring 10 mm.

Genus **Cephalophanes**, G. O. Sars.

Cephalophanes refulgens, G. O. Sars.

Cephalophanes refulgens, G. O. Sars, 1907.

Pl. V, figs. 5–7

Occurrence.—Taken in small numbers on stations S.R. 175, S.R. 193, and S.R. 197, at depths between 580 and 680 fathoms.

Genus **Onchocalanus**, G. O. Sars.

Onchocalanus cristatus (Wolfenden).

Xanthocalanus cristatus, Wolfenden, 1904.

Onchocalanus trigoniceps, G. O. Sars, 1905.

A comparison of Sars' and Wolfenden's descriptions leaves no doubt that they refer to the same species.

Occurrence.—This species is not uncommon in deep water, having been taken on six stations and in ten gatherings at depths of from 330 to 1,150 fathoms.

Onchocalanus hirtipes, G. O. Sars.

My specimen measured 5·7 mm., which is somewhat in excess of the measurement given by Sars, and the fifth pair of feet were asymmetrical, being three-jointed on one side and five-jointed on the other. In other respects there was agreement with Sars' description. The form of the genital segment in dorsal view is very characteristic, being very much narrowed anteriorly, broad in the middle, and slightly narrowed posteriorly.

Occurrence.—A single specimen was taken on station S.R. 231 at 1,150 fathoms.

Genus **Cornucalanus**, Wolfenden.

Cornucalanus chelifer (I. C. Thompson).

Scolecithrix chelifer, Thompson, 1903.

Scolecithrix chelifer, Farran, 1905.

Xanthocalanus chelifer, Farran, 1905.

Cornucalanus magnus, Wolfenden, 1905.

Onchocalanus chelifer, Pearson, 1906.

In spite of the rather inaccurate description of *Scolecithrix chelifer* given by I. C. Thompson, there can, I think, be no doubt as to the identity of the species referred to by him. I have

accordingly retained the specific name *chelifer*, while adopting the generic name of *Cornucalanus*, which was proposed by Dr. Wolfenden (1905) for a species from the "Gauss" collection, which he called *Cornucalanus magnus*. As there does not appear to be any difference between the Antarctic and N. Atlantic forms I have placed *C. magnus* as a synonym of *C. chelifer*.

Mr. Pearson (1906) has placed this species in Sars' genus *Onchocalanus*, but, as Dr. Wolfenden (1905, p. 20) has already pointed out, they are in reality quite distinct.

Occurrence.—This species is of frequent occurrence in deep-water townettings off the west coast of Ireland. It was taken on seven out of eight stations at depths of from 330 to 1,150 fathoms.

GENUS **Undinella**, G. O. Sars.

Undinella oblonga, G. O. Sars.

Occurrence.—This Arctic species was once taken, on station S.R. 139 at 1,000 fathoms.

Undinella brevipes, sp. n.

Pl. V, figs. 1–4.

Female—length 1·6 mm.

Cephalothorax stout, ovate. Cephalon slightly vaulted, partially separated from the first thoracic segment, fourth and fifth thoracic segments fused. Rostrum a flattened tapering plate, hollowed at the apex, and produced into two slender filaments. Fifth thoracic segment produced on either side into an acute point, and reaching almost to the middle of the genital segment.

Abdomen contained about three times in the length of the cephalothorax. Genital segment rather longer than broad, slightly longer than either of the two following segments; anal segment very short, almost entirely concealed. Furcal rami almost twice as long as wide. Furcal setae about as long as the abdomen.

First antenna reaches, extended, to the beginning of the genital segment. Its jointing is proportionately the same as in *U. oblonga*.

Second antenna and mandible as in *U. oblonga*.

Maxilla as in *U. oblonga*, with only two setae on the exopodite as in that species.

First and second maxillipedes resemble those in *U. oblonga*.

First foot as in *U. oblonga*.

Second foot with three-jointed exopodite and one-jointed endopodite, but the segmentation of the latter into two is plainly indicated, as it is also in my specimen of *U. oblonga*. The terminal spine of the exopodite is about equal to the combined lengths of the first and second joints, and is very finely serrulate.

The third (Pl. V, fig. 3) and fourth feet resemble those of *U. oblonga*, but have the terminal spine slightly longer in proportion.

The fifth pair of feet is symmetrical, three-jointed, but much shorter than in *U. oblonga*. The basal joints are very large and

fused in the middle line. The second joints on each side are slightly shorter, and much more slender than the basal. The terminal joints are ovate, slightly shorter than the second, bearing on one foot three short stout terminal spines or teeth, and on the other one terminal and one outer-edge tooth.

Male unknown.

The differences between this and the only other known species of the genus, *U. oblonga*, are well marked. The much smaller size, acute margins to the fifth thoracic segments, and short stout fifth pair of feet are the most noticeable points of difference.

Occurrence.—A single specimen was taken along with *U. oblonga* on station S.R. 139 at 1,000 fathoms.

GENUS **Scolecithricella,** G. O. Sars.

Scolecithricella dentata (Giesbrecht).

Occurrence.—This species is widespread off the west coast of Ireland, and often common. It occurred on all the stations except S.R. 224, on which the net used was too coarse for its capture, and in thirteen out of thirty-four gatherings, at depths of from 200 to 1,000 fathoms. On station S.R. 164 it formed 10 per cent. of the whole townetting at 200 fathoms.

Scolecithricella ovata (Farran).

Occurrence.—The vertical range of this species seems to be from the surface to 1,000 fathoms. It is of frequent occurrence over deep water off the west coast of Ireland, but is only found in small numbers. It was taken on six out of the eight stations, and in sixteen out of the thirty-four gatherings, at all depths from the surface to 1,000 fathoms.

Scolecithricella minor (Brady).

Occurrence.—This is a more common species than the records here given seem to show, but its small size probably accounts for its not having been captured oftener. It was taken on five stations at depths of from 100 to 1,000 fathoms, and has on other occasions been often taken at or near the surface.

GENUS **Scolecithrix,** Brady.

Scolecithrix magna (T. Scott).

Amallophora magna, Scott, 1894.

Scolecithrix cristata, Giesbrecht, 1895.

Scaphocalanus acrocephalus, Sars, 1900.

An examination of Scott's types in the British Museum leaves no doubt that the species described by him is the same as *Scolecithrix cristata* of Giesbrecht.

For the reasons given above, under *Xanthocalanus typicus*, I have regarded the genus *Amallophora* as a synonym of *Xanthocalanus*, and have not used it, in the sense in which it was used by Sars, for a section of Giesbrecht's comprehensive genus *Scolecithrix*. If that sub-division be regarded as of generic rank, as doubtless it should be, at least in part, the correct name for it appears to be *Scaphocalanus*. I have, however, thought it better for the present to continue to use the genus *Scolecithrix* in its larger sense.

Occurrence.—A very common and noticeable species in deep water. It occurred on every station, and in almost every townetting, between 280 and 1,150 fathoms.

Scolecithrix echinata, Farran.

Scolecithrix echinata, Farran, 1905.

Amallophora echinata, Pearson, 1906.

Pl. VI, fig 6.

I have figured the fifth foot (Pl. VI, fig. 6) as my former figure (1905, Pl. V, fig. 17) was not quite accurate. There is a very small spine on the distal extremity of the outer edge of the second joint of the exopodite of the first foot, which was not mentioned in the original description.

Occurrence.—Though frequently taken, this species is never present except in small numbers. It was taken on every station but one, at depths of from 350 to 800 fathoms.

Scolecithrix gracilipes, sp. n.

Pl. VI, figs. 1–4.

Female (Pl. VI, fig. 1)—length 2·3–2·5 mm.

Cephalothorax elongate, ovate, very slender. Cephalon slightly vaulted, fused with first thoracic segment. Fourth and fifth thoracic segments fused, the latter with the postero-lateral margins rounded, not produced.

Abdomen rather slender, slightly less than one-third of the length of the cephalothorax and equal to the second to fifth thoracic segments. Genital segment not swollen, about one and a half times as long as either the second or third abdominal segments, which are each about twice as long as the fourth segment. Furcal rami about twice as long as broad.

First antenna broken in all my specimens.

Second antenna and mouth parts almost exactly as in *S. brevicornis* and *S. echinata*.

First to fourth swimming feet as in *S. brevicornis* and *S. echinata*.

The second joint of the exopodite of the first foot (Pl. VI, fig. 2) has a small distal spine on its outer margin, as has likewise

S. echinata, my original description being in error on this point.

Fifth feet symmetrical, two-jointed, the first joint rather longer than broad, the second joint about twice as long as the first, with a small outer-edge tooth near its extremity, a terminal spine about three-quarters as long as the joint, and a long and slender inner-edge spine twice as long as the joint itself.

The fifth feet (Pl. VI, fig. 3) resemble those of *S. brevicornis*, except for the position of the tooth on the outer edge of the second joint. In my specimens it is placed comparatively near the terminal spine, dividing the outer edge in the proportion 5 : 1. In *S. brevicornis*, as figured by Sars (1900, Pl. X, fig. 14, 1903, Pl. XXXVI.), it is placed opposite the base of the inner-edge spine, dividing the outer edge in the proportion 2 : 1.

Male unknown.

It is with some hesitation that I have given a name to this species instead of recording it as *S. brevicornis*. The differences between the two are very slight, but if constant quite sufficient to distinguish them. These differences are the larger size of *S. gracilipes*, though this in itself, within the bounds of probable variation, is no valid distinction; its more slender and, compared to the abdomen, longer cephalothorax, and the more distal position occupied by the outer-edge tooth on the second joint of the fifth foot. As Sars' species is only known from a few specimens from within the Arctic circle, it seemed on the whole safer to record the N. Atlantic form under a separate name until the Northern species should become better known.

In a townetting taken 30 miles N. by W. of Eagle Island, County Mayo, in May, 1904, at 600 fathoms, there occurred a species of *Scolecithrix* which so closely resembled the above species that I have not ventured to separate it. It measured 2·7 mm., and in its external form, and in such mouth parts and limbs as remained it agreed exactly with *S. gracilipes* except as regards its fifth pair of feet. These (Pl. VI, fig. 4) had a second basal joint bearing a rudimentary endopodite inserted between the first basal and the terminal joint, both of which resembled those of *S. gracilipes*.[1] Until the contrary is shown, I should prefer to regard this as the accidental retention of a developmental character in the mature female which is to be found normally in a modified form in the immature male. The form of fifth feet in the genus *Racovitzanus* (Giesbrecht, 1902) is very similar to this, and may perhaps be explained in the same way, the genus only being known from a single specimen.

Occurrence.—*Scolecithrix gracilipes* was found on two stations, S.R. 193 at 630 fathoms, and S.R. 197 at 280, 480, and 680 fathoms, very few specimens in all being taken.

[1] A similar instance has been noticed in the case of *Scolecithrix valida*.

Scolecithrix obtusifrons (G. O. Sars).

Amallophora obtusifrons, G. O. Sars, 1905.

Solecithrix emarginata, Farran, 1905.

This species is a noticeable feature of the deep-water plankton off the west coast of Ireland. It occurred on all the stations except S.R. 164, which was perhaps too shallow for it, at depths of from 330 to 1,150 fathoms, usually in more than one townet on each station.

I submitted specimens of this species, formerly described by me (1905) as *Scolecithrix emarginata*, to Professor G. O. Sars, who was good enough to inform me that they belonged to the species described by him as *Amallophora obtusifrons*. My surmise that *S. emarginata* might prove to be a synonym of *Scolecithricella gracilis* is accordingly incorrect.

Scolecithrix globiceps, sp. n.

Pl. V, figs. 8–13. Pl. VI, fig. 8.

Female (Pl. V, fig. 13)—length 4·3–4·5 mm.

Cephalothorax elongate, ovate, the anterior part of the cephalon somewhat inflated in dorsal view, but not vaulted. Fourth and fifth thoracic segments fused; second to fifth segments together equal in length to one-third of the cephalothorax.

Abdomen contained three and a half times in the length of the cephalothorax. Genital segment not swollen ventrally, two-thirds as wide as long. Second and third abdominal segments about two-thirds as long as the genital segment. Anal segment very short. Fureal rami rather longer than wide.

First antenna longer than the body by about one joint, jointing as in *S. obtusifrons*.

Second antenna with endopodite about four-fifths as long as the exopodite and bearing 8 + 6 setae.

Mandible as in *S. robusta* and *S. obtusifrons*.

Maxilla (Pl. V, fig. 10): small exopodite of medium size, endopodite with eight setae, second basal with five setae, second and third inner lobes with two and four setae respectively.

In the first maxillipede (Pl. V, fig. 12) the large seta on the fifth lobe has a very minute, almost invisible marginal denticulation, and the largest setae on the second, third, and fourth lobes are finely denticulated. Five of the terminal sensory setae are short with bud-like terminations, the remainder, numbering four or five, are longer with rounded ends.

The basal joint of the second maxillipede (Pl. V, fig. 11) has a median sensory seta with a bud-like termination. The distal spine of the first joint has a broad base tapering abruptly to a very attenuated termination.

First foot (Pl. V, fig. 8) with three-jointed exopodite. The distal outer-edge spine of the first joint is as thick as that on the second joint, and reaches to its base.

Second foot (Pl. V, fig. 9) with curved outer-edge spine on the first joint of the exopodite nearly half as long as the second joint. The second joint bears a curved transverse row of spinules. The third joint bears a small patch of very small spinules proximally and two bands of spinules, the median one horse-shoe shaped, and the distal forming an elongate oval. Terminal spine of the exopodite coarsely serrate with about 24 denticulations.

In the third foot the second basal joint has a small patch of very small spinules at the apex of the posterior face, the second joint of the exopodite has a transverse distal band of spinules and a patch of very small spinules at its apex, the third joint has two transverse curved rows of spinules. The first and second joints of the endopodite have each two transverse rows of large spinules.

In the fourth foot the exopodite was imperfect in my specimens. The second joint of the endopodite has a transverse distal row of large spines, the third joint being bare. The outer anterior faces of both exopodites and endopodites of the third and fourth feet are minutely spinulose.

Fifth feet (Pl. VI, fig. 8) imperfectly two-jointed, the division between the joints being very faint in some specimens but more evident in others. The first joint is about as broad as long, with a patch of spinules distally near its outer edge. The second joint has a large slightly serrate spine, about as long as the joint, arising from the middle of the inner edge. The terminal spine is stout, short, about one-third of the length of the joint. On the outer margin of the joint, opposite to the base of the inner-edge spine, is a small tooth, and midway between the tooth and the base of the joint a patch of spinules similar to those on the first joint.

Male unknown.

If it had not been that this species appears to belong to Sars' genus *Amallophora*, I should have felt inclined to identify it with *Scolecithricella gracilis*, with the description of which it agrees rather well. There are not any well marked characters by which this species can be readily identified, the most noticeable being the somewhat inflated cephalon, the coarse spinulation of the terminal spines of the swimming feet and the form and spinulation of the fifth pair of feet.

In company with *S. globiceps* on one station there occurred some specimens of a *Scolecithrix* which resembled it very closely in external appearance, but which I have described below as distinct on account of some small differences, especially in the fifth pair of feet.

Occurrence.—A few specimens were taken on two stations, viz., S.R. 139, at 1,000 fathoms, and S.R. 224, at 700 fathoms.

Scolecithrix valida, sp. n.

Pl. V, figs. 14–17. Pl. VI, fig. 7.

Female (Pl. V, figs. 14, 15)—length 3·8-3·9 mm.

Cephalothorax oblong ovate, rather more robust than in *S. globiceps*. Cephalon slightly inflated as in that species, rostral

processes two, stout, slightly recurved. Fourth and fifth thoracic segments fused, the latter more constricted posteriorly than in *S. globiceps.*

Abdomen contained about three and two-third times in the length of the cephalothorax. Genital segment not swollen below, about four-fifths the length of the two following segments together. Anal segment very short. Furca small, about one and a half times as long as broad.

First antenna reaching about to the end of the second abdominal segment.

Second antenna with endopodite about four-fifths of exopodite, and bearing 8 + 6 setae.

Mandible as in *S. globiceps* and *S. obtusifrons.*

Maxilla with eight setae on the endopodite, five on the second basal, and two and four respectively on the second and third inner lobes.

First maxillipede with bud-like endings on five of the terminal sensory setae, the rest elongate with rounded tips. The bud-like ends seem to be larger than in *S. globiceps*, and the spine on the fifth lobe more slender basally, but otherwise the maxillipede agrees with that species.

Second maxillipede as in *S. globiceps*, but the distal spine on the first joint is not so strong as in that species.

The first foot (Pl. V, fig. 17) resembles that of *S. globiceps.* The outer-edge spine on the second joint seems variable in length; in one specimen it is as long as in *S. globiceps*, and in another somewhat shorter.

Second foot (Pl. V, fig. 16) as in *S. globiceps*, except as regards the terminal spine which is more finely serrate and has a broader lamina. The teeth on the terminal spine number about thirty-four, each individual tooth on the lower half of the spine being fused with its neighbour medianly but free distally and proximally. A similar arrangement of teeth is found in *S. obtusifrons*, but in that species the teeth are much finer and more closely set.

Third foot with a terminal spine similar to that of the second foot. The spinulation of the second and third feet is the same as in *S. globiceps.*

Fourth feet imperfect in my specimen.

Fifth feet (Pl. VI, fig. 7) two-jointed, first joint small, about as broad as long, second joint elongate, elavate, nearly three times as long as broad, rounded distally and narrowed basally to less than the width of the first joint for about one quarter of its length. On the middle of the inner edge is a strong finely toothed spine, and opposite it on the outer edge a small tooth. At the end of the inner edge is a stout spine about one-third the length of the joint, and in one specimen there occurred a slightly smaller spine situated on the apex of the joint.

Male unknown.

It is somewhat difficult to distinguish between this species and *S. robusta*, *S. obtusifrons* and *S. globiceps.* The fifth feet closely resemble those of *S. obtusifrons*, but the form of the last

thoracic segment distinguishes it from that species. *S. robusta* is very like it in external appearance, but is much smaller and slightly more robust, and its fifth feet are distinctly different. *S. globiceps* is extremely hard to separate without examination of the fifth pair of feet, as it is almost identical in external appearance. It is, however, a little larger and not so robust, and has proportionately a slightly longer abdomen.

Occurrence.—This species was only found on station S.R. 224 at a depth of 700 fathoms, six specimens having been taken.

Scolecithrix robusta, T. Scott.

Pl. VI, fig. 5.

Occurrence.—This species was taken on four stations at depths of from 400 to 680 fathoms.

The size of these specimens varied from 2·65 to 3·1 mm., and the inner-edge spine of the fifth foot (Pl. VI, fig. 5) was straight instead of being slightly curved as in the type.

Genus Scottocalanus, G. O. Sars.

Scottocalanus securifrons (T. Scott).

Scolecithrix securifrons, ♀, T. Scott, 1883, pars.

Scolecithrix securifrons, Canu, 1896.

Lophothrix securifrons, Wolfenden, 1904.

Scottocalanus acutus, G. O. Sars, 1905.

There seems to have been a good deal of confusion between this and the next species, *Scottocalanus persecans*, which closely resembles it, but can at once be separated by its rounded fifth thoracic segment in both sexes, whereas in *S. securifrons* the fifth segment is pointed laterally in both male and female. Scott, in his original description (1893), has indicated most clearly the female of the present species, his figures, showing the fifth thoracic segment with acute lateral terminations, and the short abdomen with large genital segment partially overlapping the second abdominal segment ventrally, being quite unmistakable. His figure of the male, however, undoubtedly refers to the following species, *S. persecans*, and in the type specimens in the British Museum the females of both species are bottled together under the name of *Scolecithrix securifrons*. Canu (1896) was the first to rediscover the species, in the "*Caudan*" Collections from the Bay of Biscay, and in his notes upon it expressly states that he uses the name *S. securifrons* for the form with the acute fifth thoracic segments. It has subsequently been recorded by Dr. Wolfenden, who places it in the genus *Lophothrix*, and Prof. G. O. Sars, who has however, as he has been good enough to inform me, described it as a new species under the name *Scottocalanus acutus*, while using Scott's name *securifrons* to designate the species with the rounded fifth thoracic segments.

Occurrence.—This species is very characteristic of deep-water townettings off the west coast of Ireland. It occurred on every station except S.R. 140, usually in the deepest nets, though on station S.R. 197 it was taken at 100 fathoms. It seemed to be most plentiful at about 700 fathoms.

Scottocalanus persecans (Giesbrecht).

Scolecithrix securifrons, T. Scott, 1893, pars.

Scolecithrix persecans, Giesbrecht, 1895.

Scottocalanus securifrons, G. O. Sars, 1905.

There are a few minor differences between the male of the Atlantic form and that described by Giesbrecht from the Pacific. In the first antennae the 20th and 21st (original) joints are separate and not partially fused as in Giesbrecht's description, and there is a partial fusion of the 14th and 15th joints on both sides. In the right fifth foot the endopodite reaches nearly to the middle of the second joint of the exopodite, and is curved towards it instead of being straight, and only slightly longer than the first joint, as in Giesbrecht's figure. The female of this species does not appear to have been described. It resembles the female of *S. securifrons*, as has been mentioned above, the fifth feet being almost identical. The most noticeable points of difference are the fifth thoracic segment, which has a rounded postero-lateral margin with a minute notch at its extremity, and the abdomen, which is rather longer and of almost uniform thickness throughout, the genital segment being scarcely swollen ventrally.

In vertical distribution and numbers this species agrees with *S. securifrons*. It was taken on five stations at depths of from 330 to 1,150 fathoms.

Genus Lophothrix, Giesbrecht.

Lophothrix frontalis, Giesbrecht.

Occurrence.—This is a very widespread and not uncommon species in the N.E. Atlantic. It was taken on every station at all depths from 330 to 1,150 fathoms, and in fifteen out of thirty-four gatherings.

Tribe HETERARTHRANDRIA.

Family *CENTROPAGIDAE.*

Genus Centropages, Kröyer.

Centropages typicus Kröyer.

Occurrence.—Found in small numbers on three stations, from the surface to 1,000 fathoms. Though occasionally occurring in deep oceanic waters, its more usual habitat is epiplanktonic and coastal.

Centropages hamatus (Lilljeborg).

Occurrence.—The capture of a very few specimens of this species on station S.R. 231 at 400 fathoms, in company with *Temora longicornis*, is rather remarkable, as both of these species are distinctly littoral, abounding in the coastal waters and estuaries of low salinity.

Genus Temora, Baird.

Temora longicornis (Müller).

Occurrence.—Though not such a distinctly littoral species as *Centropages hamatus*, yet its occurrence at 400 fathoms on station S.R. 231 is worth noting.

Genus Temoropia, T. Scott.

Temoropia mayumbaensis, T. Scott.

Pl. VI, figs. 9–15.

In spite of several small differences between my specimens, all of which were females, and Dr. T. Scott's descriptions, it seems best to designate them by the above name. I have figured the whole animal (Pl. VI, fig. 15), and some appendages, of which the existing figures are insufficient.

The length of my specimens was 7·2 to 8.0 mm.

Cephalothorax ovate in dorsal view.

Cephalon evenly rounded, not vaulted, imperfectly separated from the first thoracic segment. Rostrum short, two-pointed. Fourth and fifth thoracic segments separate.

The first antenna (Pl. VI, fig. 12) was broken in all specimens. The proportional length of the proximal joints is shown in the figure.

The maxilla (Pl. VI, fig. 11) has all its lobes developed and setiferous. The number of setae shown in the figure is approximately correct, though it is possible that some of the more minute ones may have escaped notice or been broken off. The three distal setae of the exopodite are much more slender than the rest.

The second maxillipede (Pl. VI, fig. 10) has the terminal joints rather elongate, the setae, with the exception of the two terminal ones on the last joint, being comparatively short. The jointing of the swimming feet (Pl. VI, figs 13–14) seems to be as given by Scott, but all the feet, except the first pair, were imperfect in every specimen examined.

The fifth pair of feet (Pl. VI, fig. 9) is symmetrical, and differs in this respect from that figured by Scott, in which one foot is much stouter than the other. The general form of the foot is similar, consisting of two basal joints, an exopodite about as long

as the second basal with a stout terminal spine, and a smaller tooth on the extremity of the inner margin, and a very small endopodite terminating in a long slender spine and a small seta.

If the differences in the fifth feet, between the specimens from the Gulf of Guinea and those from off the west coast of Ireland, should prove to be constant, it would necessitate their separation into two distinct species, but until more specimens of the former have been examined, it is not possible to decide this question.

Occurrence.—Found in moderate numbers in the fine silk nets on stations S.R. 193 and S.R. 197, at 630 and 680 fathoms respectively.

GENUS **Metridia**, Boeck.

Metridia lucens, Boeck.

Occurrence.—Taking both inshore and oceanic gatherings into account, this species is probably the most abundant and wide-spread of the copepods of the west of Ireland. Though it does not occur in such immense swarms as *Calanus finmarchicus*, yet it usually divides the bulk of most townettings with that species, and in winter forms the greater part. It was common at all depths investigated.

The absence of *Metridia longa* from these records is noteworthy, and is doubtless to be explained by the fact that the persistent drift from the southward checks any incursion of stragglers from its more northerly habitat, though lying so close at hand. That it does occasionally occur to the southward of its usual range is shown by Wolfenden's record of it from between 55° and 56° N. Thompson's records of *M. longa* from the Irish coast undoubtedly refer to *M. lucens*, a species which is never recorded by him.

Metridia venusta, Giesbrecht.

Metridia venusta, Giesbrecht, 1889.

Metridia Normani, ♂, Giesbrecht, 1892.

Occurrence.—This species occurs regularly in townettings, at depths of from 300 to 1,000 fathoms. It was taken on every station, and in seventeen out of thirty-four gatherings, in small or moderate numbers.

Metridia brevicauda, Giesbrecht.

Occurrence.—The records of this species are almost identical with those of *M. venusta*. It was, however, taken at the surface on station S.R. 140, and was absent from station S.R. 224, where no net suitable for its capture was used.

Metridia princeps, Giesbrecht.

Occurrence.—This noticeable species is very characteristic of offshore deep-water townettings. It was taken on every station, and in sixteen out of thirty-four gatherings at depths of from 280 to 1,150 fathoms.

Genus Pleuromamma, Giesbrecht.

Pleuromamma abdominalis (Lubbock).

Occurrence.—Though this species has often been recorded from the North Atlantic, most of the records, as has frequently been pointed out, are erroneous, and refer to *P. robusta*. *P. abdominalis* is a decidedly scarce species in the area here dealt with, and perhaps should not be regarded as a permanent denizen, as not more than three or four specimens have been met with at one time. There is very little chance of its being mistaken for *P. robusta*, as the pigmentation is markedly different, the red colour being much more diffuse and far less permanent than in that species.

Pleuromamma robusta (Dahl).

Occurrence.—Occurred on every station, and almost in every townetting from the surface to 1,000 fathoms, and was frequently present in considerable numbers. It is one of the most wide-spread and characteristic copepods of the deep water off the west coast of Ireland, but in spite of this seems rarely, if at all, to be drifted coastwards.

Pleuromamma xiphias (Giesbrecht).

Occurrence.—Taken on all the stations, except S.R. 140 and S.R. 231, at depths of from 100 to 800 fathoms, usually in small numbers. It would seem to be a permanent inhabitant of these regions.

Pleuromamma gracilis (Claus).

Occurrence.—Only absent from three stations, viz., S.R. 139, S.R. 140, and S.R. 224. Its small size and the small numbers in which it usually occurs are probably sufficient to account for its not having been taken on these occasions.

Genus Lucicutia, Giesbrecht.

Lucicutia grandis (Giesbrecht).

Leuckartia grandis, Giesbrecht, 1895.

Lucicutia grandis, Giesbrecht, 1898.

Lucicutia grandis, Wolfenden, 1904.

? *Lucicutia maxima*, Steuer, 1904.

The original specimen described by Giesbrecht from the Pacific seems to differ from the Atlantic forms merely in having the

inner edge of the second joint of the basipodite of the right fifth foot of the male somewhat swollen and spinulose. In all my specimens it was smooth and almost straight.

Wolfenden's suggestion that *Lucicutia maxima* of Steuer is identical with the present species seems very probable, though in none of my specimens were any traces of lateral hooks on the cephalothorax visible.

Occurrence.—Taken on four stations at depths of from 700 to 1,150 fathoms. On station S.R. 231 there were a considerable number of specimens present in the mesoplankton trawl at 1,150 fathoms.

Lucicutia magna, Wolfenden.

Lucicutia magna, ♂, Wolfenden, 1903.

Lucicutia atlantica, ♀, Wolfenden, 1904.

Lucicutia gracilis, G. O. Sars, 1905.

Lucicutia atlantica, Farran, 1905.

Lucicutia atlantica, Pearson, 1906.

As males agreeing with Wolfenden's *Lucicutia magna*, of which only the male has been described, and females evidently belonging to *L. atlantica*, of which the male is unknown, were taken in the same townets, I have included both species under the earlier name, as, apart from sexual differences, they agree closely with each other.

Occurrence.—Taken on seven out of the eight stations at depths of from 330 to 1,000 fathoms, usually in small numbers.

Lucicutia lucida, sp. n.

Pl. III, fig. 22. Pl. VI, figs. 16–20.

Female (Pl. VI, fig. 16)—length 3·5 mm. *Male*—3·25 mm.

Cephalothorax ovate in dorsal view. Cephalon broader anteriorly than in *L. magna*, without lateral processes. Rostral papilla not visible in dorsal view.

Abdomen about two-thirds of the length of the cephalothorax. In the female the genital segment is about twice as long as broad, with a small ventral prominence. The two following segments are of equal length, and together equal to the genital segment. The anal segment is about three-quarters as long as the genital segment. The furcal rami are moderately long, about four and a half times as long as broad, and slightly shorter than the genital segment. They are very richly furnished with lueiferous glands. The furcal setae are short and slender, the outermost seta arising at the distal two-fifths of the outer margin. There is a very minute seta situated on the outer margin, between the outermost seta and the base of the ramus.

In the abdomen of the male (Pl. VI, fig. 18) the first and second segments together are equal to the third and fourth

together, and slightly shorter than the furca. The anal segment is about three-quarters as long as the furca. The furcal rami agree in proportions and setae with those of the female.

The first antennae (Pl. VI, fig. 17) when extended reach about to the end of the body in both sexes, the total length in the female being 3·2 mm., and in the male 3·0 mm.

Length of joints of first antenna of female in ·01 mm :—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18	19	20	21.	22.	23.	24	25.
7.	4.	5.	6.	7.	7	6.	8.	8.	8.	9.	9.	15	15.	18.	20.	20.	22.	20.	20.	15.	15.	18.	16.	0.

Length of joints of left geniculated antenna of male in ·01 mm :—

1 2.	3.	4.	5.	6	7.	8.	9.	10	11.	12.	13.	14.	15	16	17.	18.	19. 20. 21.	22. 23.	24.	25.
24.	7.	6.	8.	8	8.	7.	7.	7.	8.	8.	10.	16.	19.	20.	20.	18.	33.	40.	19.	11.

The right antenna of the male is similar to that of the female. The mouth parts are similar in both sexes, and do not show any noticeable features, being almost identical with those of *L. magna*.

The first to fourth pairs of swimming feet are similar in both sexes. The first foot (Pl. VI, fig. 20) has a three-jointed endopodite and a medium-sized tubular process on the second basal joint. The terminal spine of the exopodite is slightly longer than the third joint, and about equal to half the exopodite.

The second to fourth feet are of the usual type in the genus, and resemble each other. The terminal exopodite spines are short, about equal in length to the second and third joints of the endopodites. All the terminal spines of the exopodites are very minutely serrulate.

The fifth foot (Pl. VI, fig 19) in the female has the terminal spine of the exopodite short, contained two-and-a-half times in the length of the third joint, and equal to about half the endopodite. The inner-edge spine on the second joint of the exopodite is slender, and more than half the length of the third joint.

In the male the fifth pair of feet (Pl. III, fig. 22) are of the usual form, except that the spinous process of the basipodite of the right foot is on the first instead of on the second joint. The second joint of the basipodite is smooth. The exopodite and endopodite are each two-jointed, the former with a strong distal spine on the outer edge of the first joint, the latter with the second joint less foliose than usual. The left foot has a large rounded process, bearing a few spinules, on the second joint of the basipodite. This is badly shown in the figure, the joint having become distorted in mounting before it was drawn. The exopodite and endopodite resemble those of *L. flavicornis*.

Of the known species of *Lucicutia* with a three-jointed endopodite on the first foot, viz., *L. flavicornis*, *L. longicornis*, *L. grandis*, *L. maxima* and *L. curta*, the first two may be distinguished from *L. lucida* by their much smaller size; *L. grandis*, and *L. maxima*, if distinct, are about twice as large, and *L. curta* differs in its stout robust form and shorter caudal rami.

Of the two new species recently described by Prof. G. O. Sars the jointing of the endopodite of the first foot is not mentioned, but in *L. intermedia* the genital segment of the female is

equal to the two following segments conjointly, and the outer edge seta of the furca is situated at the middle of the outer margin, while in *L. tenuicauda* the furca is equal in length to the rest of the abdomen. None of these characters agree with those found in *L. lucida*.

Occurrence.—Two specimens of this species, a male and a female, were taken on station S.R. 197 at a depth of 680 fathoms.

Lucicutia curta, Farran.

Lucicutia curta, Farran, 1905.

Occurrence.—Taken on six out of eight stations, from the surface to 1,000 fathoms.

Lucicutia longiserrata (Giesbrecht).

Pl. VI, figs. 21-22.

Occurrence.—Two specimens, a female and a male, apparently belonging to the same species, were taken on Station S.R. 224 at 700 fathoms. Though the female measured 3·0 mm. while Giesbrecht's *L. longiserrata* was only 2·2 mm., yet the agreement in other respects was so near that I have recorded it under the above name. The only noticeable difference was in the tubular basal process of the first foot (Pl. VI, fig. 21), which was not so long as shown in Giesbrecht's figure.

Lucicutia flavicornis (Claus).

I have included under the above name a few small specimens of *Lucicutia* which occurred, one or two at a time, in some of the gatherings. They measured from 1·5 to 2·0 mm., and agreed in all their main features with *L. flavicornis* as described by Giesbrecht, the differences between them being well within the limits of the variations recorded by him.

The specimens were too few to make any detailed study of, but it is perhaps worth noting that in examining the females they seemed to fall into two groups separated as follows :—

(1.) Solid tapered tubercle, notched at its extremity, on second basal of first foot; outer margin of third joint of exopodite of fifth foot with four teeth on its proximal moiety.

(2.) Low flat cylindrical tubercle on second basal of first foot; outer margin of third joint of exopodite of fifth foot with its proximal moiety smooth; inner-edge spine of second joint of exopodite not so long as in (1). Animal slightly larger.

Occurrence.—On four stations at depths between 200 and 1,000 fathoms.

Genus **Heterorhabdus,** Giesbrecht.

Heterorhabdus norvegicus (Boeck).

Occurrence.—The most plentiful species of its genus. Present on all stations except S.R. 164, and almost in every townetting from the surface to 1,150 fathoms. The absence of the species from S.R. 164 cannot indicate a southern limit to its range, as Dr. Wolfenden took it between 51° and 52° N., but it is possibly due to a thinning out of its numbers.

Heterorhabdus spinifrons (Claus).

Occurrence.—This species occurred on six out of the eight stations, but always in small numbers. Specimens of the female from this area reach a length of 4·0 mm.

Heterorhabdus abyssalis (Giesbrecht).

Heterochaeta abyssalis, Giesbrecht, 1889.

Heterorhabdus abyssalis (?), Farran, 1905.

Occurrence.—One specimen of a female, length 2·65 mm., similar to specimens from the west coast of Ireland, which I formerly referred to this species, was taken on station S.R. 139 at a depth of 1,000 fathoms, in company with a male agreeing closely with Giesbrecht's description of *H. abyssalis*. Another specimen of the female was taken at 400 fathoms on the same station.

Heterorhabdus robustus, sp. n.

Heterorhabdus vipera, Farran, 1905.

Pl. VII, figs. 1–10.

Female (Pl. VII, figs. 1, 2)—length 3·5–4·0 mm. *Male*—3·4–3·7 mm.

The cephalothorax is stout and robust in both sexes, but not as much so as in *H. compactus*. Rostral prominence low, just visible in dorsal view.

Abdomen measuring about half the length of the cephalothorax, with large dilated genital segment in the female. Furcal rami (Pl. VII, fig. 3) equal in length to the two preceding segments taken together.

The first antennae reach, when extended, slightly beyond the genital segment.

Second antennae as in *H. compactus*.

Mandibles as in *H. vipera*, the cutting edge of the right mandible (Pl. VII, fig. 5) with four denticles, the two median bifid, the distal curved and laminate, and very slightly longer than the rest. The cutting edge of the left mandible (Pl. VII, fig. 4) bears three denticles, the distal very long and sickle-shaped.

The maxilla (Pl. VII, fig. 7) resembles in form that of *H. vipera*, but differs in having longer setae on the endopodite.

The first maxillipede (Pl. VII, fig. 6) resembles that of *H. vipera*. In the figure the feathering and serrulation of the setae and spines is not shown.

The second maxillipede is as in *H. vipera* and *H. compactus*, the median seta on the first joint being small and slender.

The first to fourth swimming feet (Pl. VII, fig. 10) in both sexes resemble those of *H. vipera* and *H. compactus*.

The fifth feet in the female (Pl. VII, fig. 9) only differ from those of *H. vipera* in having the inner-edge spine on the second joint of the exopodite slightly shorter than the third joint. In *H. vipera* it is longer than the third joint, while in *H. compactus* it is equal to it.

In the male the left fifth foot (Pl. VII, fig. 8) is of the same general form as that of *H. vipera*, but differs in the shape of the third joint of the exopodite, which is more ovate, and bears shorter spines. The right fifth foot (Pl. VII, fig. 8) differs considerably from that of *H. vipera*, the third joint of the exopodite and the processes on the second joint and on the second basal joint being of a totally different form.

H. robustus is an addition to that section of *Heterorhabdus*, represented by *H. vipera*, *H. compactus* and *H. brevicornis*, which is distinguished by the absence of a long median spine on the first joint of the second maxillipede, and the presence of a broad foliose exopodite on the third foot. In Sars' original description of *H. compactus* he has described and figured the fourth foot as being foliose, instead of the third, but this is clearly an oversight. *H. atlanticus* is separated from this section by having the third and fourth feet similar and without foliose exopodites, as in *H. longicornis*.

On account of the resemblance of *H. robustus* ♀ to *H. compactus*, I forwarded specimens to Prof. G. O. Sars, who kindly informed me that they were quite distinct. The principal points of difference have been referred to above.

H. robutus ♀ is only distinguishable from *H. vipera* by its larger size and the above-mentioned differences in the maxilla and fifth feet. My former record of a large form of *H. vipera* (1905) in reality refers to *H. robustus* and must be deleted. The difference between the fifth feet of the males of the two species is much more noticeable. The description of *H. brevicornis* is very incomplete, but its very small size, 2·0 mm., is a sufficient, though not satisfactory, distinction.

Occurrence.—This species was taken on stations S.R. 139, S.R. 140, S.R. 175 and S.R. 224 at depths of from 330 to 1,000 fathoms, usually in small numbers. It is probably a permanent inhabitant of the Irish deep-water area.

Heterorhabdus Grimaldii, Richard.

Occurrence.—This very fine species, the largest of its genus, and differing considerably in structure from all the other members, was taken on three stations, viz., S.R. 139, at 800 fathoms,

S.R. 224, three specimens at 700 fathoms, and S.R. 231, six specimens at 1,000 fathoms. It is evidently a permanent though rather scarce inhabitant of the area.

Heterorhabdus longicornis (Giesbrecht).

The specimens met with of both sexes may be separated into two groups according to their sizes, those from 3·0 to 3·5 mm. and those measuring about 4·5 mm. These groups occurred together but intermediate specimens were not found. As no structural differences between the two sizes could be made out I have included them all under the name of *H. longicornis*.

Occurrence.—Taken on every station but S.R. 164 from the surface to 1,150 fathoms.

GENUS Mesorhabdus, G. O. Sars.

Mesorhabdus brevicaudatus (Wolfenden).

Heterorhabdus brevicaudatus, Wolfenden, 1905.

Mesorhabdus annectens, G. O. Sars, 1905.

Mesorhabdus brevicaudatus, G. O. Sars, 1907.

Occurrence.—In small numbers on three stations at depths of from 580 to 680 fathoms.

GENUS Disseta, Giesbrecht.

Disseta palumboi, Giesbrecht.

Disseta palumboi, Giesbrecht, 1889.

Heterorhabdus grandis, Wolfenden, 1904, 1905.

Heterorhabdus grandis, Pearson, 1906.

Dr. Wolfenden's figures of *Heterorhabdus grandis* (1904, Pl. IX, fig. 36; 1905, Pl. IV, figs. 7-8) furnish unmistakable proof of the identity of that species with *Disseta palumboi*.

Occurrence.—This species is evidently widely distributed in small numbers in the deep-water area, having been taken on five stations at depths of from 680 to 1,150 fathoms—from one to seven specimens of both sexes on each station.

GENUS Haloptilus, Giesbrecht.

Haloptilus longicornis (Claus).

Occurrence.—This species was taken in very small numbers on five stations at depths of from 200 to 630 fathoms. As other records go to show that this is an epiplanktonic species, widespread in the N.E. Atlantic, it is possible that the deeper records,

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600 fathoms on stations S.R. 175 and S.R. 193, may refer to specimens taken during the ascent of the net. Dr. Wolfenden, using closing nets only, found the species between 100 and 200 fathoms.

Haloptilus acutifrons (Giesbrecht)

Occurrence.—This species seems rather scarcer than the preceding, having been only taken on three stations, in all cases in company with *H. longicornis*. Probably its scarcity is due to a more restricted northern range.

Haloptilus tenuis, sp. n.

Pl. VII, figs. 16–22.

Female (Pl. VII, fig. 18)—length 4·62 mm.

Cephalothorax ovate, elongate, broadest at its anterior third. Cephalon (Pl. VII, fig. 17) very much vaulted and with an anterior caecum, distinctly mucronate in lateral view, but with the point scarcely visible when seen dorsally.

Abdomen (Pl. VII, fig. 16) short, contained about six times in the length of the cephalothorax. Genital segment as long as broad, and one and a half times as long as the two following segments taken together. Anal segment equal to the second and third abdominal segments taken together, and a little shorter than the furca. Furcal setae short, the appendicular seta very long and slender.

The first antenna is longer than the body by about three joints. Its total length is 4·7 mm.

Length of joints in 0·1 mm. :—

1.	2.	3.	4.	5.	6.	7.	8.	9	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
24.	9.	9.	9.	12.	12.	12.	12.	14.	14.	17.	20.	24.	26.	27.	27.	29.	29.	25.	20.	21.	18.	21.	21.	16.

In the second antenna (Pl. VII, fig. 19) the exopodite is a little more than half as long as the endopodite.

The mandibular palp is elongate and slender, the two branches being of equal length. The cutting edge of the mandible bears one large and three small teeth as in *H. mucronatus*.

The maxilla (Pl. VII, fig. 21) resembles that of *H. acutifrons* in general form. The outer lobe bears three minute setae followed by six large setae, the most proximal of the large setae being considerably thicker than the rest. The exopodite has four medium-sized outer-edge setae, two large terminal setae, and five very small setae on the extremity of the inner edge. The endopodite is one-jointed, and bears a medium terminal seta and two or three small setae. The second basal bears five setae, the three median being the largest. The third inner lobe is knob-shaped and bears three setae, the second one seta, and the first five spines much longer and more slender than in *H. acutifrons*.

The first maxillipede (Pl. VII, fig. 20), has none of its setae modified into spines. The three terminal setae are the largest and smooth, except for a slight distal pectination.

The second maxillipede is of the ordinary form, the proportional length of the joints being 18 : 13 : 7 : 6 : 5 : 4 : 2. The large setae on the four last joints are almost smooth.

The first to fourth pair of swimming feet have no noticeable features.

In the fifth feet (Pl. VII, fig. 22), the terminal spine of the exopodite is three-fourths as long as the third joint. The inner-edge seta of the second joint is very slender, and about half as long as the joint. It is very finely feathered.

Male unknown.

This species in external appearance and size approaches very near to *H. spiniceps*, but its abdomen is proportionately a little longer and the cephalic spine not so prominent. It also differs in the maxilla, which in *H. spiniceps* has only two setae on the endopodite, and in the first maxillipede, which in *H. spiniceps* has strong hooks on the fifth and sixth lobes. It agrees with *H. acutifrons* in the form of the maxilla and first maxillipede, but differs in the shape of the body and in being considerably larger. Of the other species with cephalic spines *H. oxycephalus*, *H. mucronatus* and *H. aculeatus* have the head much more acute, and *H. ocellatus* is about twice as large, besides differing in other respects.

Occurrence.—Three specimens of *H. tenuis* were taken on stations S.R. 139, 800 fathoms; S.R. 175, 600 fathoms; and S.R. 224, 700 fathoms.

Haloptilus fons, sp. n.

Pl. VII, figs. 11–15.

Female (Pl. VII, fig. 11.)—length 5·7–6·6 mm.

Cephalothorax about three times as long as wide in dorsal view, the sides parallel and the ends rounded. Cephalon shaped somewhat as in *H. chierchiae*, but with the rostral papilla not so evident, very slightly vaulted, and rather angular in outline. Anterior caecum absent.

Abdomen (Pl. VII, fig. 15) a little more than one-fourth the length of the cephalothorax. Genital segment about as broad as long, and one and a half times as long as the two following segments taken together. Second abdominal segment slightly longer than the third, the two together being about four-fifths as long as the anal segment. Furcal rami slightly longer than broad, the appendicular setae being moderately long and slender.

The first antennae are longer than the body by about five joints, their length in a specimen measuring 6·6 mm. being 8 mm.

Length of joints of first antenna in ·01 mm. :—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
42.	18.	21.	21.	23.	23.	21.	21.	23.	24.	29.	35.	42.	42.	42.	42.	42.	41.	36.	27.	29.	27.	35.	30.	23.

The second antennae resemble in some respects those of *H. chierchiae*, particularly in the exopodite, which shows the division between the first and second joints well marked. The endopodite

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is shorter and thicker than in *H. chierchiae*, the first joint being equal in length to the exopodite. The second basal joint is thick, and about two-thirds as long as the first joint of the endopodite. It bears two distal setae which are not so long as the single seta of *H. chierchiae*.

The mandibular palp is of the same form as in *H. ornatus*. The cutting edge (Pl. VII, fig. 13) is of a form not found in any other members of the genus. It is strongly chitinised, and bears five teeth, the two distal being strong and multicuspid, the two following each with a single small cusp on their dorsal margin, and the lowest simple and slender.

The maxilla (Pl. VII, fig. 14) resembles most nearly that found in *H. chierchiae*, but differs in the exopodite, which bears two large distal setae, four smaller outer-edge setae and five very small inner-edge setae, that of *H. chierchiae* having eight sub-equal setae. The endopodite, like that of *H. chierchiae*, is imperfectly three-jointed, but bears $4 + 4 + 5$ setae instead of $3 + 1 + 3$ as in that species.

The first maxillipede, as in *H. chierchiae*, has three setae on the second and third lobes. The setae on the fifth and sixth lobes are no thicker than the largest setae on the following joints.

The second maxillipede resembles that of *H. mucronatus*, the proportional lengths of the joints being 30 : 24 : 9 : 8 : 6 : 5 : 2.

The swimming feet show some noticeable features. The first feet resemble those of *H. chierchiae*, but lack the setose patches on the outer margin of the exopodite.

The terminal spines of the exopodites of the second to fourth feet are unusually long, that of the second foot being as long as the third joint of the exopodite, and that of the fourth foot being two-thirds as long as the same joint of its exopodite.

The fifth pair of feet (Pl. VII, fig. 12) agree in most points with those of *H. chierchiae*, but may be distinguished by the longer inner-edge spine with thickened base of the second joint of the exopodite.

Male unknown.

Haloptilus fons is more closely allied to *H. chierchiae* than to any other described species of the genus. The latter species was, as Giesbrecht has pointed out, the least specialised member of the genus, but in most of the points in which *H. fons* differs from *H. chierchiae* an even less degree of specialisation is noticeable, particularly in the cutting edge of the first joint of the basipodite of the mandible. In *H. fons* the cutting edge is broad, heavily chitinised, and provided with strong multicuspid teeth, while throughout the rest of the genus it is narrow, weak, and provided with two or three simple or notched teeth. This dissimilarity is doubtless correlated with some slight difference in food or methods of feeding, which has, perhaps, induced the further specialisation shown in the elongation of the second antennae and the reduction of setae on the maxilla and first maxillipede.

H. angusticeps, recently described by Prof. G. O. Sars, also agrees with this species in its well developed mandible and its maxilla with a three-jointed endopodite. It is, however, considerably smaller, and apparently of a much more slender form, with shorter antennae.

Occurrence.—*Haloptilus fons* was taken on two stations, viz., S.R. 175, one specimen at 600 fathoms, and S.R. 231, one specimen at 1,000 fathoms.

Genus **Augaptilus**, Giesbrecht.

This genus was founded by Giesbrecht in 1889 to receive *Hemicalanus longicaudatus* of Claus; at the same time he added five new species, and, in 1892, also included *Hemicalanus filigerus* of Claus; G. O. Sars, in 1893, adding *A. glacialis*, and T. Scott, in 1894, *A. Rattrayi*. The recent large increase of the genus was initiated by Wolfenden when, in 1902, he described *A. zetesios*, followed in 1904 by *A. magnus* and *A. gibbus*, Stener in 1904 also adding *A. fungiferus*. The total number of species was, in 1905, brought up to twenty-six by Sars' description of thirteen new species from the Prince of Monaco's collections, and five were subsequently added by him in 1907 from the same source. As of these thirty-one species only nine have been figured, it has become a matter of some difficulty to correctly identify specimens, particularly in view of the fact that there does not seem any probability of the limits of the genus having been reached.

In the collections here dealt with the genus is represented by eighteen species, four of which I have described as new, the rest being referred to species already known.

The difficulty of subdividing this very cumbrous genus does not seem to have been simplified since Giesbrecht, in 1892, foreseeing the increase which has now become an accomplished fact, provisionally included all the species then known under one generic name. The separation of the *longicaudatus* group, which apparently contains the type of the genus, and which is characterised by the extreme reduction of its maxilla and the length of its abdomen and furca, has become more marked, but of the remaining species it is impossible to use any arrangement which does not separate species which in some points closely resemble each other; e.g., if the nature of the maxilla be used as a means of classification, such totally dissimilar forms as *A. bullifer* and *A. Rattrayi* will be placed together, while if the presence or absence of a rostrum be regarded as of importance, two such closely allied forms as *A. squamatus* and *A. laticeps* will be separated.

Augaptilus elongatus is apparently the most primitive form, and in it, as also in *A. nodifrons*, the endopodite of the maxilla is indicated as a distinct joint, thus forming a link with the genus *Haloptilus*.

Augaptilus elongatus, G. O. Sars.

Augaptilus elongatus, G. O. Sars, 1905.

Prof. G. O. Sars' description clearly indicates the species referred to, and only needs to be supplemented by a more detailed description of the maxilla. The first inner lobe of the maxilla

bears ten moderate curved spines, the second lobe one large and one small seta, the third lobe two small setae. The basipodite, second joint, or, as Sars calls it, the first joint of the endopodite, is furnished with three medium setae. The endopodite itself is a very small, almost square, joint with three terminal setae. The exopodite is long and narrow, with seven setae, the two terminal being the largest. The outer lobe bears six large setae situated distally to three very fine setae. My specimens agreed in size with those originally described.

Occurrence.—Taken on three occasions, on station S.R. 175, at 600 fathoms; S.R. 224, at 700 fathoms; and S.R. 231, at 1,150 fathoms.

Augaptilus nodifrons, G. O. Sars.

Augaptilus nodifrons, G. O. Sars, 1905.

My specimens, all females, differed from those described by Sars in having three inner-edge lobes on the maxilla, the first well developed, the second and third small, and each with a single terminal seta. The type specimen is described as having only two inner-edge lobes. The rest of description agrees very closely with my specimens, the noticeable specific characters being the nodular rostral prominence without filaments, the two-branched mandible with a well developed cutting edge, the jointed endopodite with two terminal setae, the absence of buttons on the maxillipedes, and the stout curved spine on the inner edge of the second joint of the exopodite of the fifth pair of feet.

The size of the specimens met with mostly varied between 5·4 and 5·7 mm., but one, taken on station S.R. 231, reached 7·1 mm.

Occurrence.—This is not an uncommon species, having been taken on five stations at depths of from 580 to 1,150 fathoms.

Augaptilus laticeps, G. O. Sars.

Augaptilus laticeps, G. O. Sars, 1905.

Being doubtful as to whether my identification of this species was correct, I submitted it to Prof. G. O. Sars, who was good enough to inform me that the specimen sent was *A. laticeps*, pointing out at the same time that it might be distinguished from *A. squamatus* by the fact that the latter has no rostral appendages, while in *A. laticeps* they are present as a pair of slender filaments

Colour.—This species may at once be distinguished from all others in a townetting by its light olive green colour which is retained for a long time, at least two years, by specimens preserved in formaline.

Occurrence.—This is a moderately frequent species in deep water, having been taken on six stations at depths of from 400 to 1,150 fathoms.

Augaptilus brevicaudatus, G. O. Sars.

Augaptilus brevicaudatus, G. O. Sars, 1905.

My identification of this species was kindly confirmed by Prof. G. O. Sars. The following particulars added to his description will make the species more easy of recognition. Mandible two-branched, cutting edge feebly developed with one large curved tooth occupying more than half the edge, two equal slender teeth, and one very minute acicular proximal tooth. Maxilla with eleven spines on first inner lobe, one and two setae on the second and third inner lobes, two setae on the very rudimentary endopodite, two equal setae on the extremity of the exopodite, and six setae on the outer lobe. First and second maxillipedes with sensory buttons.

Colour.—The colour of this species is unusual, consisting of a patch of rich deep brown round the mouth, the rest of the body being colourless except for a scanty brown shading on the second antenna and the exopodite of the mandible.

Occurrence.—Occurred in small numbers on five stations, at depths of from 350 to 1,150 fathoms.

Augaptilus facilis, sp. n.

Pl. III, figs. 23, 24.

Pl. VIII, figs. 1–6.

Female—length 5·4 mm.

Cephalothorax elongate, oval, slightly more than three times as long as broad. Rostrum of two slender filaments rising from a papilla.

Abdomen contained about three and three-fourth times in the length of the cephalothorax. Genital segment about equal to the second and third abdominal segments and furca taken together, the proportional lengths of the abdominal segments and furca being 9 : 3 : 4 : 3. Furca about one and a half times as long as broad, with short, sparingly plumose setae. Appendicular seta slightly shorter than the innermost terminal seta, and directed obliquely outwards.

The first antenna is longer than the body by about five joints, the proportional length of the joints in ·01 mm. being

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20	21.	22.	23.	24.	25.
30.	12.	16.	18.	20.	21.	22.	22.	24.	27.	30.	36.	36.	36.	34.	34.	33.	35.	36.	32.	32.	30.	35.	35.	26.

The second antenna (Pl. VIII, fig. 2) has both branches of about equal length. The second basal joint bears one very small terminal seta, the second joint of the endopodite 6 + 7 setae. The exopodite is distinctly eight-jointed, with a distal inner-edge seta on each of the joints, those on the fourth and fifth joints being the largest, and that on the seventh joint almost obsolete. The inner-edge seta of the last joint is situated on the extreme distal margin of the joint close to the base of the three terminal setae.

The mandible has a feebly developed two-branched palp, the endopodite without setae, the exopodite five-jointed, with a small seta on each of the four terminal joints. The cutting edge of the mandible (Pl. VIII, fig. 6) is broad, with two large bicuspid teeth, two small teeth, one acicular and the other short, and a proximal articulated spine, the small teeth lying close together, the others widely separated.

The maxilla (Pl. VIII, fig. 5) has the first inner lobe with eight spines, the second with one strong seta, and the third with a slender seta. The exopodite bears three terminal setae and the outer lobe four setae.

The first maxillipede (Pl. VIII, fig. 3) is short, having the setae on the first joint arranged in groups of 2 + 2 + 3, and on the second joint of 2 + 2. The four terminal joints are very much shortened, each bearing two setae of equal size.

The second maxillipede (Pl. III, fig. 24) has setae of moderate length arranged in groups of 1 + 3 + 3 on the first joint, and on the second joint two moderate + one moderate and one long seta, the third joint having two short and two long seta, the fourth three short and one long, the fifth and sixth each two short and one long, and the seventh two very short and one long. All the longer setae on both the maxillipedes bear small but distinct sensory buttons.

The first foot is of the usual form, but has no outer-edge spine on the second joint of the exopodite and only one on the third.

The second foot has the outer-edge spines of the third joint of the exopodite very small and deeply set.

In the third and fourth feet (Pl. III, fig. 23) the second joint of the exopodite has its outer edge below the terminal outer-edge spine produced into a blunt process overlapping the spine, and in the third joint of the exopodite there is a similar process between the second and third outer-edge spines, which reaches beyond the end of the joint. The terminal spine of the exopodite of the third foot is about as long as the third joint; in the fourth foot it is a little shorter. The terminal spines of the second to fifth feet are very finely serrulate.

The fifth foot (Pl. VIII, fig. 4) is of the usual form with the inner-edge seta of the second joint of the exopodite straight and slender and finely plumose, reaching to just beyond the base of the first inner-edge seta of the third joint.

Male unknown.

This species seems to come nearer to *A. gracilis* than to any other described species, but differs from Sars' description of that species in its shorter abdomen, which in *A. gracilis* measures more than one-third of the length of the cephalothorax, and in having sensory buttons on the setae of the first and second maxillipedes, these structures being absent in *A. gracilis*.

Occurrence.—One specimen of *Augaptilus facilis* was taken on station S.R. 197 at a depth of 680 fathoms.

Augaptilus gibbus, Wolfenden.

Augaptilus gibbus, Wolfenden, 1904.

Augaptilus gibbus, G. O. Sars, 1905.

Prof. G. O. Sars informs me that he considers the species described by him as *A. gibbus* as synonymous with that described a little earlier by Dr. Wolfenden, by a curious coincidence, under the same name. The maxilla in my specimen differed from that described by Dr. Wolfenden in having eight spines on the first inner lobe. The second inner lobe bore a single strong seta. The third was only indicated, and was without setae. The exopodite bore four rather slender setae and the outer lobe seven setae, the three central ones large, the outer ones extremely small. The length of my specimen, a female, was 3·36 mm.

Occurrence.—One specimen was taken on station S.R. 193 at a depth of 630 fathoms.

Augaptilus palumboi, Giesbrecht.

Occurrence.—This species occurred on four stations at depths between 600 and 1,000 fathoms. It is probably a permanent inhabitant of the region dealt with, its small size accounting for the comparatively few records.

Augaptilus bullifer, Giesbrecht.

Occurrence.—Only one specimen was met with, on station S.R. 231, at 1,150 fathoms.

Augaptilus truncatus, G. O. Sars.

Augaptilus truncatus, G. O. Sars, 1905.

Prof. G. O. Sars, to whom I submitted a specimen, was good enough to confirm my identification of this species. The maxilla in my specimens was very much reduced, the first inner lobe bearing six weak slender spines, the second and third lobes almost obsolete, but each with a minute terminal hair. The exopodite was long and slender, with one very minute and two medium setae. The outer lobe bore six medium setae.

Occurrence.—Three specimens were taken at 1,150 fathoms on station S.R. 231, and one at 1,000 fathoms on station S.R. 139.

Augaptilus similis, sp. n.

Pl. VIII, figs. 7–14.

Female—length 7·4–8·1 mm.

Cephalothorax moderately robust, ovate. Rostrum of two slender filaments on a prominent papilla.

Abdomen about one-third as long as the cephalothorax. Genital segment slightly longer than the two following segments and the furca taken together. Anal segment equal to the furca, and about one and a half times as long as the second abdominal segment. Furcal rami nearly twice as long as broad, and separated by about their own width. The furcal setae are rather setose, the second from within being about twice as long as the rest, and the appendicular seta very small and slender.

The first antenna is longer than the body by about three joints. Proportional length of joints in ·01 mm.:—

1.	2.	3.	4.	5.	6.	7	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19	20.	21.	22.	23.	24.	25.
20.	12.	16.	16.	16.	17.	18	18.	19.	21.	25.	32.	44.	44.	46.	46.	48.	48.	48.	38.	38.	34.	36.	32.	24

In the second antenna (Pl. VIII, fig. 11) the endopodite is very slightly longer than the exopodite. The first joint of the endopodite is equal in length to the second basal joint; the second joint is more than twice as long as the first joint, and bears 6 + 8 setae. The exopodite is faintly eight-jointed, the seta on the inner edge of the second joint being absent, but those on the other joints well developed.

The mandible is two-branched, the endopodite being small and two-jointed, with three distal setae; the exopodite four-jointed, with five setae. The cutting edge (Pl. VIII, fig. 13) bears two strong bicuspid teeth, two slender simple teeth, and a pectinate articulated spine.

The maxilla (Pl. VIII, fig. 9) is feebly developed, the first inner lobe bearing five weak spines, the second and third lobes absent, the second basal, or endopodite, with one seta as in *A. bullifer*, the exopodite elongate with one long terminal seta and one very minute and one small outer-edge seta, and the outer lobe with five stout setae.

The first maxillipede (Pl. VIII, fig. 8) is long, the first joint with $x + 1 + 2 + 3$ setae, the second joint with $3 + 3$ setae, the remaining joints very much shortened, bearing twenty sub-equal closely crowded setae with well-developed sensory buttons (Pl. VIII, fig. 12).

The second maxillipede (Pl. VIII, fig. 7) is very long, the first joint with $1 + 2 + 3$ very small setae, the second joint with $2 + 2$ small setae, the third joint with two long and two very small setae, the fourth joint with one long and three very small setae, the remaining three joints each with one large and one or two very small setae. All the large setae bear well-developed sensory buttons.

The first foot is of the usual form. The outer-edge seta on the first joint of the exopodite is longer than the two following joints. There is one very small outer-edge spine on the second joint of the exopodite, and two similar spines on the third joint.

The second to fourth feet have no noticeable characteristics. The outer-edge spines on the third joints of the exopodites are small and deeply set.

The fifth foot (Pl. VIII, fig. 14) has the seta on the inner edge of the second joint of the exopodite stiff and moderately setose,

and standing almost at right angles to the inner margin of the joint; if adpressed it would reach to between the first and second inner-edge setae of the third joint.

Colour.—Body colourless, containing a little red oil; base of first antenna, endopodite of second antenna, and three outer furcal setae of an olive-green colour.

Male unknown.

This species is in some points closely allied to *A. truncatus*, but differs very markedly in the arrangement of setae on the terminal joints of the first maxillipede.

Occurrence.—Taken on stations S.R. 224 and S.R. 231 at 700 and 1,150 fathoms, four specimens in all having been met with.

Augaptilus magnus, Wolfenden.

Augaptilus magnus, Wolfenden.

? *Augaptilus fungiferus*, Steuer.

The body of this species is colourless, but usually contains orange-red oil drops, crowded round the mouth and gut, and in the female the ovary shows as two opaque lateral masses of a salmon pink colour joined together anteriorly. It seems possible, but by no means certain, that the *Augaptilus fungiferus* of Steuer is a synonym.

Occurrence.—This noticeable and easily distinguished species is of frequent occurrence in the deep water townettings, and is often taken in considerable numbers It was found on every station from depths of 100 fathoms, on S.R. 164, to 1,150 fathoms, on S.R. 231.

Augaptilus angustus, G. O. Sars.

Augaptilus angustus, G. O. Sars, 1905.

This species is easily recognised by its long antennae, the absence of rostral filaments and of sensory buttons on the maxillipedes, and by the three distal setae on the basal, or, as Prof. G. O. Sars calls it, the endopodal part of the maxilla. The animal when alive is suffused with vermilion, most deeply on the region round the mouth, and contains numerous orange-red oil globules.

Occurrence.—On every station, but in very small numbers, at depths of from 350 to 1,150 fathoms.

Augaptilus filigerus (Claus).

The colouring in life consists of vermilion on the first and second maxillipedes and circum-oral area, and in a less degree on the second antenna, and of a faint reddish tinge on the first antenna. There are small orange oil drops scattered through the

body, and the tip of the exopodites of the second to fourth feet contains a small patch of highly refractive greenish-yellow oil drops, possibly with a photogenic function.

Occurrence.—Taken on seven stations at depths of from 350 to 1,150 fathoms.

Augaptilus Rattrayi, T. Scott.

Pl. VIII, fig. 21.

The colouring, as is the case in many members of the genus, is characteristic. It consists of a small, very deeply-coloured circular brown patch round the mouth, the rest of the body being colourless. In very few instances was this pigment spot absent. This species must be distinguished from the following closely allied but much larger *A. horridus.*

Occurrence.—This species, first recorded from the Gulf of Guinea, seems to be a permanent inhabitant of the N.E. Atlantic. It was taken on six stations at depths of from 350 to 1,150 fathoms.

Augaptilus horridus, sp. n.

Pl. VIII, fig. 20.

Female—length 10 mm.

Cephalothorax robust, resembling in general form that of *A. Rattrayi,* but much more vaulted anteriorly, the cephalon being almost conical both in dorsal and lateral view. The whole surface is closely covered, as in *A. Rattrayi,* with short stiff hairs or bristles.

The abdomen, mouth organs, and swimming feet are identical with those of *A. Rattrayi.*

In none of the specimens found was there any trace of pigment visible.

Its much larger size and conical cephalon are sufficient to distinguish this species without difficulty from *A. Rattrayi.* Another difference is the absence in *A. horridus* of the brown pigment patch which is almost always present in the smaller species.

Occurrence.—This species is not a common one, having only been taken on three stations at depths of from between 630 and 1,150 fathoms, most of the specimens being immature.

Augaptilus longicaudatus (Claus).

If I am correct in referring all the specimens to this one species *A. longicaudatus* exhibits a great variability in size, measuring from 3·6 to 6·1 mm., the intermediate sizes being frequently met with.

The animal is sometimes colourless, but is usually marked by an oval patch of opaque olive green dorsally on the second thoracic

segment; sometimes, but rarely, a similar patch is present on the fourth segment. *Augaptilus longicaudatus* is said to be distinguished from all other members of the genus which possess an elongate furca by having ten large setae on the terminal joints of the second maxillipede, all the other described species, viz., *A. megalurus*, *A. glacialis*, and *A. zetesios*, having only five such setae. Amongst the specimens of what appeared to be *A. longicaudatus* in the collection it was found, however, that all the females of 4·5 mm. and over had fifteen, or perhaps in some cases fourteen, large terminal setae on the second maxillipede and one specimen, measuring 5·9 mm., had also fifteen, instead of the usual seven setae on the terminal joint of the first maxillipede. A male specimen, which measured 4·8 mm., had only the normal number of setae on both maxillipedes. As no other points of difference could be made out, I have not ventured at present to regard those I have mentioned as specific, though I have no knowledge of a parallel instance among the copepoda. The variation above referred to is, it should be noted, in the nature and not the number of the setae, the third joint of the second maxillipede having, in the alternative instances, three large and one small, or four large setae.

Occurrence.—This species occurred tolerably frequently in the townettings, having been taken on all the stations, except S.R. 140, at depths of from 100 to 1,150 fathoms, usually nearer the latter.

Augaptilus anceps, sp. n.

Plate VIII, figs. 15–19.

Female—length 3·75 mm.

Cephalothorax elongate ovate. Cephalon slightly vaulted, somewhat tapered anteriorly, but not so much as in *A. zetesios*.

Abdomen (Pl. VIII, fig. 15) contained about two and four-fifth times in the length of the cephalothorax. The genital segment is almost symmetrical, and about one and a half times as long as the two following segments taken together, the approximate relative lengths of the abdominal segments and furca, measuring the latter along its inner margin, being 6 : 2 : 2 : 3. The furca is about four times as long as wide, the appendicular seta being about as long as the abdomen exclusive of the furca. The other furcal setae were broken.

The first antenna exceeds the body by about four joints, the approximate lengths of the joints in ·01 mm. being—

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18	19.	20.	21.	22.	23.	24.	25.
18.	6.	6.	6.	7.	7.	7.	7.	12.	15.	18.	24.	25.	25.	25.	25.	26.	27.	24.	21.	22.	18.	18.	18.	16.

The second antenna has an endopodite slightly longer than the exopodite, with 6 + 6 terminal setae. The exopodite is five-jointed but the limits of the joints can only be made out with difficulty. The outer-edge setae cannot be referred to their respective joints, their arrangement (Pl. VIII, fig. 17) being more easily figured than described. The proximal of the two large outer-edge setae found in *A. zetesios* and *A. glacialis* is only represented by a small papilla.

The mandible agrees fairly well with that of *A. glacialis.*

The maxilla (Pl. VIII, fig. 19) has only one seta on the inner lobe, as in *A. longicaudatus*; the endopodite bears two equal terminal setae, and the exopodite one very large and one small seta.

The first and second maxillipedes agree in form and number of setae with those of *A. zetesios* and *A. glacialis*; the first lobe of the second maxillipede, however, bears three setae, while Wolfenden's figure of *A. zetesios* shows only two.

The first to fourth feet resemble those of *A. glacialis* and *A. zetesios*, the teeth on the outer edge of the exopodite of the first foot showing the same compound structure as is shown in Wolfenden's figures.

The fifth feet are very similar to those of *A. zetesios*, the inner-edge spine on the second joint of the exopodite (Pl. VIII, fig. 18) reaching to the base of the third inner-edge seta of the third joint. The spine is very strong, straight and coarsely denticulate, the proximal denticulations being larger than are figured by Wolfenden for *A. zetesios.*

Male unknown.

This species is very closely allied to *A. glacialis* and *A. zetesios*, but is considerably smaller than either. It differs from both in having the exopodite of the second antenna shorter than the endopodite, and bearing only one large lateral seta, and also in having only one seta on the inner lobe of the maxilla. The furcal rami are considerably shorter than in either species, and the proportional lengths of the abdomen and its segments also differ. From *A. megalurus* it may be separated by its smaller size, shorter genital segment, and the presence of the strong denticulate spine on the exopodite of the fifth foot.

Occurrence.—One specimen of the above was taken, on station S.R. 197 at 580 fathoms.

Augaptilus megalurus, Giesbrecht.

These specimens differed in some small points from *A. megalurus* as described by Giesbrecht from the Pacific, so it seemed advisable to give some figures in case the Atlantic form may turn out to be specifically distinct.

The total length was 5·7–6·1 mm. in females and 5·0 mm. in males, as against 4·5 mm. and 4·0 mm. as given by Giesbrecht. The abdomen was contained three times in the length of the cephalothorax. The proportional length of the abdominal segments agrees fairly well with Giesbrecht's description, but the genital segment is slightly shorter and the anal segment slightly longer. The whole body is very elongate and stiff, with a vaulted conical cephalon, and forms a noticeable contrast to the more rounded lines and general stouter form of *A. longicaudatus.* The jointing of the first antenna agrees in general with the typical *A. megalurus*, but the terminal joints are in the proportion 15:12:12; the proportion shown in Giesbrecht's figure being about 21:19:20. The exopodite and endopodite of the second antenna are of equal length in the

female, the exopodite being the longer in the male. The remaining appendages agree well enough with the published description, but some small points of difference may be made out in the form of the fifth pair of feet of the male.

Occurrence.—Taken in small numbers on four stations between 600 and 700 fathoms.

Genus **Pontoptilus**, G. O. Sars.

Pontoptilus muticus, G. O. Sars

Pontoptilus muticus, G. O. Sars, 1905.

I sent drawings of the single specimen found to Professor G. O Sars, who kindly informed me that it agreed fairly well with the form recorded by him as *P. muticus*. I have accordingly recorded it under that name. It is easily recognised by its very robust form and opaque coarsely dotted integument, which is of a reddish brown colour. The rostrum is absent, the first antenna is almost as long as the body, and the fifth feet have a two-jointed endopodite. The endopodite of the maxilla consists of two large oval joints, each bearing a single seta. The length of the specimen was 6·0 mm.

Occurrence.—A single specimen, a female, of this species was taken on station S.R. 140 at a depth of 750 fathoms.

Pontoptilus abbreviatus, G. O. Sars.

Pontoptilus abbreviatus, G. O. Sars, 1905.

Professor G. O. Sars was good enough to examine the drawings of the *Helga* specimens, and writes to me that they are apparently *P. abbreviatus.*

This species is transparent and colourless, except for a small group of olive-brown spots on either side of the cephalon, close to the postero-ventral angle, and a few orange oil globules near the base of the maxillipedes. The rostrum consists of two slender filaments; the first antenna exceeds the body by about four joints; the endopodite of the maxilla bears numerous setae, and the endopodite of the fifth foot is one-jointed.

Occurrence.—This species is evidently more common than the last, single specimens, all females, having been taken on three stations at depths of from 630 to 1,150 fathoms.

Genus **Arietellus**, Giesbrecht.

None of the specimens of *Arietellus* in the collection can be referred to the Mediterranean *A. setosus*. They comprise three, if not four, of the species recently described by Professor G. O. Sars, my identification of them having been kindly confirmed by their author. The specific characters lie almost entirely in the form of the cephalothorax, the last thoracic segment, and the furcal rami and setae; the resemblance between the appendages of the various species being so close as to afford no grounds for their discrimination.

Arietellus simplex, G. O. Sars.

Arietellus simplex, G. O. Sars, 1905.

A. simplex is distinguishable from other described species by its large size, rounded fifth thoracic segments, and comparatively long furcal rami.

Occurrence.—This is perhaps the best represented species of the genus in the collection. It was taken on five stations at depths of between 700 and 1,000 fathoms.

Arietellus pavoninus, G. O. Sars.

Arietellus pavoninus, G. O. Sars, 1905.

This species, like *A. simplex*, has the lateral margins of the fifth thoracic segment rounded, but it is easily distinguished by its smaller size (5·25 mm. in my specimen), broad robust body, and the short, widely divergent, furcal rami.

Occurrence.—A single specimen was taken on station S.R. 224 at a depth of 700 fathoms.

Arietellus plumifer, G. O Sars.

Arietellus plumifer, G. O. Sars, 1905.

Occurrence.—This species was taken on five stations at depths between 350 and 1,000 fathoms. It occurred in somewhat smaller numbers than *A. simplex*, and many of the specimens were immature.

Arietellus, sp.

In addition to the above-mentioned species, there occurred a few specimens which approached rather closely to *A. Giesbrechti*, but showed no sign of the asymmetry which characterises that species. Prof. G. O. Sars tells me that since the publication of his description he has met with other specimens of *A. Giesbrechti*, in which the asymmetry was much less marked. It seems advisable, in consequence, to defer consideration of the species till a larger series of specimens can be examined.

Genus Paraugaptilus, Wolfenden.

Paraugaptilus Buchani, Wolfenden.

Paraugaptilus Buchani, Wolfenden, 1904.

Occurrence.—A single specimen, female, was taken on station S.R. 193, at 600 fathoms. Its bright lemon yellow colour when alive was rather remarkable.

GENUS **Phyllopus**, Brady.

In a former paper I referred the specimens of *Phyllopus* taken off the west coast of Ireland to Brady's original species, *P. bidentatus*. An examination of a large number of specimens has convinced me that this view cannot be sustained, and that all the Irish specimens must be recorded as belonging to the two new species which I have described below.

Phyllopus Helgae, sp. n.

Phyllopus bidentatus, partim, Farran, 1905.

Pl. IX, figs. 5, 6.

Female—length 2·3–2·4 mm. *Male*—2·4 mm.

The body of the female is short and robust, broadly rounded anteriorly. The fifth thoracic segment is contracted posteriorly, the lateral margins being rounded, and very slightly produced.

The abdomen (Pl. IX, fig. 5) is contained two-and-one-third times in the length of the cephalothorax, the proportional length of the abdominal segments and furca being about 8 : 3 : 3 : 4 : 3; the second segment is, however, very slightly longer than the third. The genital segment is asymmetrical, the paired genital openings being placed diagonally, that on the right being the most anterior. There is a low tubercle placed ventrally on the middle of the right side, and a small chitinous papilla on the left side close to the postero-ventral margin.

The first antennae reach to about the middle of the genital segment, the proportional length of the joints in ·01 mm. being

1–2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
15.	6.	6.	6.	6.	6.	4.	3.	3.	3.	3.	3.	5.	6.	7.	9.	10.	11.	12.	11.	9.	9.	9.	11.

The other cephalic appendages and the first to fourth feet do not apparently differ from those of *P. bidentatus*, as figured by Giesbrecht. The fifth pair of feet are slightly asymmetrical, the right being a little longer than the left. They have already been figured by me (1905, Pl. XI, fig. 21) in the paper referred to above. They differ from both Giesbrecht's and Brady's figures by the greater elongation of all the joints, particularly the third, and by the smaller size of the setae on the outer edge of the second joint.

The male resembles the female in general form, but is not quite so robust. It has already been figured by me in sufficient detail (1905, Pl. XI, figs. 12–19) under the name of *Phyllopus bidentatus*.

Occurrence.—This species is by far the most common Phyllopus in the gatherings, having been taken on every station but S.R. 224, and almost in every townetting between 300 and 750 fathoms, males being slightly more numerous than females.

Phyllopus impar, sp. n.

Phyllopus bidentatus, Scott, 1894.

Phyllopus bidentatus, partim, Farran, 1905.

Plate IX, figs. 1–4.

Female—length 2·65–3·0 mm. *Male*—2·95 mm.

The female is stout and robust, the cephalothorax resembling that of *P. Helgae* except for the fifth thoracic segment, which is moderately contracted posteriorly, and produced to form lateral pointed wings on each side of the genital segment, reaching to the middle of the segment on the left, and to the end on the right side.

The abdomen is shorter than in *P. Helgae*, being contained about two-and-a-half times in the length of the cephalothorax. The proportionate lengths of the abdominal segments and furca are approximately 9 : 5 : 4 : 7. The genital segment is considerably broader than long, owing to a very large dextral and a somewhat smaller sinistral tubercle. The furcal rami are about twice as long as broad, and slightly longer than the anal segment.

The first antenna reaches to about the end of the genital segment, the proportional lengths of the joints in ·01 mm. being

1–2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
18.	7.	7.	6.	7.	7.	5.	3·5.	3·5	3·5.	3·5.	3·5.	4.	5.	6.	8.	9.	11.	12.	10.	9.	7.	9.	12.

The remaining cephalic appendages, and the first to fourth feet, seem to agree with those of *P. bidentatus*, as figured by Giesbrecht, and those of *P. Helgae* described above.

The fifth pair of feet are five-jointed, the basal joints being very short and fused along their inner margins. The second joint on the right side is entirely unarmed; on the left side in one specimen it bears a very short spine on the distal margin of the posterior face close to the outer edge; in another specimen this spine is missing. The third joint (first joint of the exopodite) is about as broad as long, and bears a small distal outer-edge spine, flanked externally by a very small denticle. The second joint of the exopodite bears a long curved seta on its inner margin—the outer margin being armed by two denticles. The terminal joint bears six denticles, arranged in pairs on its outer margin, and a strong short distal spine.

I have figured (Pl. IX, figs. 3, 4) the fifth feet of what I believe to be the male of this species. The animal in general appearance, and in most of its appendages resembled the male of *P. Helgae* referred to above. It was, however, rather larger, and showed some differences in the form of the fifth feet, the wing on the first joint of the left foot being considerably smaller, and the terminal hook of the same foot shorter and more curved.

A specimen of *P. impar*, previously taken by the *Helga* off the West of Ireland had been referred by me (1905, p. 45) to *P. bidentatus*, where, in a passage pointing out its resemblance

to the *P. bidentatus* figured from the Gulf of Guinea by Dr. T. Scott, by an unfortunate misprint the fifth thoracic segment was described as symmetrical.

Occurrence.—Two females of this species were taken on station S.R. 139. at depths of 600 and 1,000 fathoms, and two males on S.R. 175, at 600 fathoms.

Family *CANDACIIDAE.*

Genus **Candacia**, Dana.

Candacia rotundata, Wolfenden.

Candacia rotundata, Wolfenden, 1904,

Candacia inermis, Cleve, 1904.

Candacia obtusa, G. O. Sars, 1905.

(Pl. IX, fig. 15).

The male of this species was met with on a few occasions. It measures 3·8 mm. in length. The fifth thoracic segment is rounded on the left side as in the female, but on the right its postero-ventral angle is produced into a slender dorsally curved hook. The right side of the genital segment bears an elongate blunt tubercular process partly overlapping the second segment, and on the left side of the genital segment is a low tubercle. The fifth pair of feet (Pl. IX, fig. 15) is very like that of *C. longimana*, but the terminal joint of the left foot is proportionally much shorter.

Occurrence.—Taken in small numbers on six stations at depths of between 350 and 760 fathoms.

Candacia norvegica, Boeck.

Occurrence.—Taken on six stations at depths of between 400 and 1,000 fathoms. It occurred in thirteen townettings as against the nine in which *C. rotundata* was found.

Candacia gracilimana, sp. n.

(Pl. IX, figs. 7–14).

Male—length 2·25 mm.

Form of body resembling in general that of *C. armata*, the fifth thoracic segments being produced into a sharp point on each side of the genital segment, but not, however, blackened as in that species. The point on the right side is slightly the longer.

The abdomen is rather shorter than in *C. armata*, being contained slightly more than two-and-a-half times in the length of the

cephalothorax. The genital segment (Pl. IX, fig. 11) bears a pointed process on the right side as in *C. armata* and *C. curta*, but directed slightly forwards instead of backwards as in those species. The left side of the genital segment bears a small inconspicuous tubercle.

The first antenna is twenty-four-jointed, reaching a little beyond the genital segment, the thick basal portion consisting of seven joints. The proportional length of the joints of the left antenna is approximately the same as in *C. norvegica*, but the twenty-second and twenty-third joints are together equal to the twenty-fourth. The clasping mechanism of the seventeenth and eighteenth joints of the right antenna (Pl. IX, fig. 12) resembles that of *C. norvegica*, the seventeenth joint having very fine toothing all along its upper margin, and the eighteenth a short longitudinal row of fine teeth on its proximal end.

The second antenna and mandible resemble those of *C. norvegica*.

The maxilla (Pl. IX, fig. 10) bears on the first inner lobe one strong terminal hooked spine with a small spine near its base and nine setae. The second inner lobe is very long and slender. The second basal bears two setae and a minute spine, and the endopodite 2 + 5 setae.

The first maxillipede (Pl. IX, fig. 13) is moderately elongate, rather more so than in *C. armata*, the first joint bearing on the first lobe three slender setae, on the second a minute hair, and on the third a moderate seta and a minute hair. The third joint is elongate, about half as long as the first, and three times as long as wide.

The second maxillipede has no distinctive marks.

The swimming feet (Pl. X, figs. 7–9) resemble those *C. longimana*, except that the first foot is more slender, and has no setae on the second basal joint.. The terminal spine of the exopodite of the third foot is short and bent, but not quite so much as in *C. longimana*.

The serration of the proximal and median divisions of the outer edge of the third joints of the exopodites of the second to fourth feet is only slightly finer than that of the distal portions.

The fifth feet (Pl. IX, figs. 13, 14) resemble those of *C. longimana*, but the moveable claw (second and third joints of exopodite) of the right foot ends in a much more curved point than in that species.

Female unknown.

This species evidently belongs to that group of the genus represented by *C. norvegica*, *C. longimana*, and *C. tenuimana*. It is not improbable that it may turn out to be the as yet undescribed male of the last named, but as *C. tenuimana* has not been recorded from the N. Atlantic, the use of a new name seems to be the course least likely to lead to confusion.

Occurrence.—One specimen was taken on station S.R. 139 at 400 fathoms and another on S.R. 140 at 350 fathoms.

FAMILY *PONTELLIDAE.*

GENUS **Anomalocera**, Templeton.

Anomalocera Patersoni, Templeton.

Occurrence.—This species is widely distributed at the surface on the west coast of Ireland, but usually in small or moderate numbers, never apparently occurring in the vast swarms which at times indicate its presence in the Irish Sea. There are only three records of its occurrence in the present collection, a few specimens having been taken at the surface on station S.R. 140, one in the large triangle net at 700 fathoms at S.R. 193, and three in the mesoplankton trawl at 1,000 fathoms on S.R. 231. The last two records may be put down to accidental captures during the ascent of the net.

GENUS **Bathypontia**, G. O. Sars.

Bathypontia elongata, G. O. Sars.

Professor G. O. Sars informs me that the drawings of this species which I sent him agreed exactly with the form described by him. It is, perhaps, worth noting, however, that in my specimens the eighth and ninth and twenty-fourth and twenty-fifth joints of the first antenna were fused.

The male does not differ noticeably from the female except in the form of the clasping antennae and of the fifth pair of feet. The clasping antenna (Pl. IX, fig. 16) is nineteen-jointed, the eleven proximal joints being narrow and distinctly separated from the following four somewhat thickened and ill-defined joints. The sixteenth joint is strongly bowed and is followed by three unaltered joints as in the female. The fifth feet (Pl. IX, fig. 17) are almost symmetrical, and consist on each side of four elongate tapering joints, the last joint terminated by a small spine.

Occurrence.—Three specimens were met with, one, a male, on station S.R. 193 at 600 fathoms, and the others, both females, on S.R. 197 at 700 fathoms and S.R. 224 at 700 fathoms.

GENUS **Acartia**, Dana.

Acartia Clausi, Giesbrecht.

Occurrence.—In the deep water off the west coast of Ireland this copepod is, apparently, always present at all depths from surface to 1,000 fathoms, usually in large numbers. Its absence from some of the townettings recorded in the table is to be explained by the large size of the mesh used on those occasions.

This is the only member of the genus which I have met with off the west coast of Ireland except in the bays and harbours with water of low salinity where *A. discaudata* is associated with it.

I do not think any of the west coast records of *A. longiremis* can be regarded as trustworthy, though there is of course no reason why it should not sometimes be found there.

SUB-ORDER Podoplea

TRIBE AMPHARTHRANDRIA.

FAMILY *MORMONILLIDAE.*

GENUS Mormonilla, Giesbrecht.

Mormonilla phasma, Giesbrecht.

Occurrence.—Taken in small numbers in the fine-meshed townets, at 600 fathoms on station S.R. 175 and 680 fathoms on S.R. 195.

Mormonilla minor, Giesbrecht.

Mormonilla minor, Giesbrecht, 1891.

Mormonilla polaris, G. O. Sars, 1900.

Mormonilla atlantica, Wolfenden, 1905.

My specimens show the triple jointing of the endopodite of the first foot, on which both Sars and Wolfenden rely for the separation of their species from *M. minor*, but as Giesbrecht in his detailed description of *M. minor* qualifies his statement that the endopodite is two-jointed by saying that, while the first and second joints are fully separated, the second and third are fused "bis auf eine zarte Grenzlinie," I do not think that any dependence can be put on that character. Some of my specimens seemed to show an additional joint in the first antenna immediately distal to the first long seta, but as the appearance of a joint can be produced by folding the antenna at any point, this character, too, is somewhat unreliable.

Occurrence.—In small numbers on stations S.R. 193, 630 fathoms, and S.R. 197, 680 fathoms, being taken in company with *M. phasma* on the latter station.

FAMILY *CYCLOPIDAE.*

GENUS Oithona, Baird.

Oithona similis, Giesbrecht.

Occurrence.—Taken on four stations. As it is apparently widespread and common off the west coast of Ireland its absence from some townettings may doubtless be put down to its small size.

Oithona plumifera, Baird.

The correct name for this common N.E. Atlantic species of *Oithona* still seems to be somewhat doubtful. It is usually recorded as *O. plumifera*, but sometimes apparently as *O. setigera*. It agrees most nearly with what Giesbrecht regards as *O. plumifera*, but differs in having four setae on the endopodite of the mandible instead of three, and also in the larger size of the single seta on the endopodite of the maxilla. The plumose setae attached to the sides of the thorax, figured by both Baird and Giesbrecht in *O. plumifera*, have never been present in any of the specimens which I have seen, but it is possible that they have been broken off.

Occurrence.—On six out of eight stations, often being moderately plentiful.

Genus Paroithona, nov.

Closely allied to *Oithona*, which it resembles in general form and in the jointing of the cephalothorax and abdomen. The rostrum, in the only known species, is absent. The first and second antennae and the mandible are as in the genus *Oithona*. The maxilla has three well-developed inner lobes, the endopodite represented by a lobule without setae and the exopodite apparently absent. The first and second maxillipedes are as in the genus *Oithona*. The swimming feet have each a three-jointed exopodite and two-jointed endopodite, the fifth pair of feet being represented by a single seta on each side of the fifth segment.

Paroithona parvula, sp. n.

Pl. X, figs. 1–13.

Female—length ·46 mm.

General form of body resembling that of *Oithona nana*, but with shorter abdomen. The second, third and fourth (anal) segments of the abdomen are of equal length and slightly more than half as long as the genital segment. The furcal rami (Pl. X, fig. 3) are one-and-a-half times as long, and bear six setae. The innermost furcal seta is about one-and-a-half times as long as the furca, the second is moderately large but broken off close in all my specimens, the third is three times as long as the furca, the fourth very small, the fifth about as long as the furca, and the appendicular seta strong and exceeding the total length of the abdomen. The rostrum is absent, the front of the cephalon resembling that of *Oithona nana*, but being rather more rounded. (Pl. X, fig. 2).

The first antenna (Pl. X, fig. 4) reaches to the beginning of the fourth thoracic segment. It is six-jointed and bears numerous long setae.

The second antenna (Pl. X, fig. 5) is two-jointed, the basal joint with one outer-edge seta; the second joint, representing the

fusion of the second and third joints in *Oithona*, with two short setae on the proximal part of the outer edge, three setae at the point of fusion of the joints and five terminal setae increasing in size from without inwards.

The mandible (Pl. X, fig. 10) resembles rather closely that of *Oithona nana*. The exopodite is not segmented and bears four setae. The endopodite is small, about two-and-a-half times as long as broad, and bears four small setae. The terminal portion of the second basal carries a single strong curved prickle-bearing spine.

The maxilla (Pl. X, fig. 6) has the three inner lobes well developed; the first with five strong spines, the second with a single seta and the third with one large and one small seta. The endopodite is only represented by a small bare lobule. The presence of an exopodite could not be made out.

The first maxillipede (Pl. X, fig. 11) is of the same general form as in *Oithona nana*, but does not apparently bear more than two setae on any of its lobes.

The second maxillipede (Pl. X, fig. 9) is four-jointed, the first joint with 3 + 1 setae, the second with 1 + 1, the third with 3, and the fourth with 2 + 1, the longer setae on the third and fourth joints being bent backwards as in the genus *Oithona*.

All the swimming feet (Pl. X, figs. 7, 8, 12, 13) have three-jointed exopodites and two-jointed endopodites. The outer-edge spines of the exopodites are arranged as 1, 1, 2 on the first three feet and 1, 1, 1 on the fourth foot. The inner edge setae are arranged as 0, 1, 3 on the first foot, 0, 1, 5 on the second and third feet and 0, 0, 5 on the fourth feet. The terminal spines of the exopodites are very long and slender.

The endopodites have an outer-edge seta on the first joint in the first and fourth feet, but not in the second and third feet.

The second joint of the endopodite in the first foot bears eight setae, in the second foot seven setae, in the third foot five setae, and in the fourth foot five seta.

The fifth foot is represented on either side of the fifth thoracic segment by a single seta.

Male unknown.

In the foregoing description and in the accompanying figures the numbers of the setae must be regarded as being somewhat doubtful, since, on account of the minute size and extreme transparency of the specimens, it was a matter of some difficulty to discover whether the smaller setae and spines were present or not.

Occurrence.—This species was present in moderate numbers in the fine silk townets at 630 and 680 fathoms on stations S.R. 193 and S.R. 197.

It seems not unlikely that Thompson's (1903) record of *Oithona nana* from deep water in the N.E. Atlantic refers in reality to this species.

Family *HARPACTICIDAE.*

Genus **Microsetella**, Brady and Robertson.

Microsetella rosea, Dana.

All the specimens of *Microsetella* found belonged to this species, which is easily distinguishable from *M. atlantica* by the longest furcal seta being twice as long as the body instead of equal to it, and also by the different form of the fifth foot.

Occurrence.—In the fine silk nets at stations S.R. 193 and S.R. 197, at 630 and 680 fathoms respectively.

Genus **Clytemnestra**, Dana.

Clytemnestra rostrata, Brady.

Occurrence.—A single specimen was taken in the fine silk net at 630 fathoms, on station S.R. 193.

Genus **Aegisthus**, Giesbrecht.

Aegisthus mucronatus, Giesbrecht.

The *Helga* specimens agree closely with Giesbrecht's figures and description, and cannot be referred to Wolfenden's *A. atlanticus*, as both the exopodite and endopodite of the first foot are only imperfectly three jointed and the fifth foot has only an indication of a basal joint. *A. longirostris* described from the Gulf of Guinea by Dr. T. Scott, is separated from both *A. mucronatus* and *A. atlanticus* by having two setae on the inner edge of the fifth foot.

Occurrence.—A few specimens were taken on three stations, S.R. 175, at 600 fathoms, S.R. 224 at 700 fathoms, and S.R. 231 at 400 fathoms.

Family **Monstrillidae.**

Genus **Monstrilla**, Dana.

Monstrilla longicornis, I. C. Thompson.

Monstrilla longicornis, I. C. Thompson, 1890.

Monstrilla longicornis, Giesbrecht, 1892.

This genus is mainly an inhabitant of littoral or shallow waters, the earlier stages of its life history being passed within the bodies of certain tubicolous polychaets worms, so that its capture forty miles from shore in waters of over 650 fathoms in depth is rather unusual.

Occurrence.—A single specimen, a full grown female, was taken at 630 fathoms on station S.R. 193.

Tribe ISOKERANDRIA

Family *ONCAEIDAE.*

Genus **Oncaea**, Philippi.

Oncaea mediterranea (Claus).

Occurrence.—A single female specimen was taken at 1,000 fathoms on station S.R. 139. Its bright orange colour and thickened integument are sufficiently remarkable to call attention to the animal, so that it is not likely to have been passed over on other occasions, as might easily happen with other members of the genus.

Oncaea conifera, Giesbrecht.

Occurrence.—This is by far the most plentiful species of Oncaea occurring off the west coast of Ireland. It was taken on six stations, and almost always when the mesh of the net was small enough to prevent its passage it formed a noticeable feature in the gathering. It apparently occurs at all depths from the surface to 1,000 fathoms.

Oncaea ornata, Giesbrecht.

Occurrence.—Next to *O. conifera* this seems to be the commonest Oncaea of the N.E. Atlantic off the Irish coast. It occurred on five stations at depths between 530 and 1,000 fathoms.

Oncaea notopus, Giesbrecht.

Occurrence.—This species was taken in moderate numbers at 630 fathoms on station S.R. 193, and 680 fathoms on S.R. 197.

The specimen measured ·95 mm., the size of Giesbrecht's typical examples, while those from the Arctic Ocean, as recorded by Sars (1900) measured ·7 mm., and from the Antarctic (Giesbrecht, 1902) only ·65 mm.

Oncaea subtilis, Giesbrecht.

Occurrence.—Taken at the surface on station S.R. 193, and in small numbers in the 680 fathom net on S.R. 197. This species seems to be quite distinct from *O. curvata* from the Antarctic.

Oncaea minuta, Giesbrecht.

I have recorded the *Helga* specimens under the name of *O. minuta* as they agree very closely in structure with that species, although of distinctly larger size. The females measured from ·68 to ·76 mm., the males ·62 mm.; whereas the female of *O. minuta* measures ·56 to ·58 mm. The first antenna has joints

of the same proportional length as in *O. minuta*. The second antenna agrees with Giesbrecht's figure of that of *O. venusta*. In the mandible the denticulation of the larger laminate appendage is subterminal. The maxilla and first maxillipede show no distinctive marks. The second maxillipede agrees with Giesbrecht's figure of that of *O. minuta*.

The outer-edge spines of the exopodites of the swimming feet are reduced in size; in the fourth foot the outer edge spine of the second joint does not reach to the base of the first outer-edge spine of the third joint, as is also the case with *O. minuta*. The third joint of the endopodite of the fourth foot ends in a blunt conical process. The proximal outer-edge seta of the same joint seems to be without a denticulate lamina, but it is difficult to be sure of this, as some specimens seem to show a trace of it. The fifth feet are similar to those of *O. minuta*.

Occurrence.—In the fine silk nets on stations S.R. 193 and 197, at 630 and 680 fathoms respectively, in moderate numbers.

Oncaea exigua, sp. n.

Pl. X, figs. 25–29.

Pl. XI, figs. 10–12

Female—length ·48–·52 mm.

Anterior division of the body ovate, the cephalon being rather broad and equal in length to the four following thoracic segments. Genital segment very large, at least two-thirds of the whole abdomen; genital openings rather far apart and situated in front of the anterior third of the genital segment. The second and third abdominal segments are extremely short, the anal segment about two-thirds as long as broad, and the furcal rami slightly longer than the anal segment and twice as long as broad.

The first antenna is six-jointed, the proportional lengths of the joints being approximately, 3 : 4 : 5 : 12 : 3 : 1 : 3. The segmentation between the last two joints is, however, not fully developed.

The second antenna (Pl. X, fig. 26), resembles that of *O. subtilis*, the terminal joint being as long as the basal and considerably longer than the second.

The structure of the mandible and maxilla was not satisfactorily made out.

The first maxillipede (Pl. X, fig. 28), has the terminal claws more slender than usual, but shows no other difference in structure.

The second maxillipede (Pl. X, fig. 29) has the second joint about two-and-a-half times as long as its greatest width, and bearing two strong lateral spines, the distal finely denticulate and about one-and-a-half times as long as the proximal which is smooth. The distal margin of the joint bears about six minute spinules close together, and proximal to them two more distant but similar spinules. On the opposite face of the joint to the

two large spines and slightly in front of the larger there are two short very fine setae which might easily be overlooked but appear to be constant. A similar pair of setae seem to be present in *O. curvata*. The terminal claw of the maxillipede is smooth.

The swimming feet (Pl. X, fig. 27, Pl. XI, figs. 10–12) are of the usual form, but none of the endopodites end in a conical process and their terminal spines are long and slender and not laminate. The lamina is apparently absent from the outer-edge spines on the third joints of the exopodites of all feet, and of the first joint of the fourth foot. There are only two outer-edge spines on the third joint of the exopodite of the first foot, and in the fourth foot only one. The outer-edge spine of the second joint of the exopodite of the fourth foot is absent.

The fifth foot is reduced to a minute nodule and bears a single seta.

Oncaea exigua differs markedly from any already described species. It agrees with *O. subtilis* and *O. curvata* in having an elongated terminal joint to the second antenna and no conical termination to the fourth foot endopodite, but it differs entirely from either in the form of its abdomen. The reduction of the number of spines on the outer edge of the exopodites of the first and fourth swimming feet is not found in any other species of *Oncaea*.

Occurrence.—This very minute species occurred in small numbers in the fine silk nets at 630 and 680 fathoms on stations S.R. 193 and 197.

Oncaea obscura, sp. n.

Pl. X, figs. 14–23.

Female—length ·5 mm. *Male*—·5 mm.

Female with the anterior division of the body regularly ovate in dorsal view, about two-and-one-fifth times as long as broad.

Abdomen (Pl. X, fig 23) contained two-and-a-half times in length of cephalothorax. The genital segment is nearly twice as long as broad, of uniform thickness, not inflated, as most species of *Oncaea* are. The second and third abdominal segments are short and the anal segment about as broad as long. The furcal rami are slightly shorter than the anal segment and twice as long as wide.

The first antenna is jointed, the proportional length of the joints being approximately, 4 : 9 : 16 : 5 : 2 : 4.

The second antenna (Pl. X, fig. 14) is of the same form as in *O. conifera* but the second joint has the upper edge finely serrate as in *O. ornata*. The spines of the proximal group on the third joint are all of about the same thickness.

The mandible (Pl. X, fig. 16) and maxilla (Pl. X, fig. 18), resemble those of *O. conifera*.

The first maxillipede is as usual.

The second maxillipede (Pl. X, fig. 15) has a moderately broad second joint with two small marginal spines, the proximal

smooth, the distal serrate. The upper margin of the joint distal to the serrate spine is finely setose. The inner margin of the terminal claw is very finely denticulate. The basal joint is produced anteriorly into a stout thumb-like process.

The swimming feet (Pl. X, figs. 19–21) have the usual number of spines and setae, the laminate spines of the exopodites being well-developed. Conical terminal processes are present on the endopodites of the first three feet, but absent from the fourth. The terminal spine of the endopodite of the fourth foot is unusually long, being about two-thirds as long as the third joint.

The fifth foot on either side consists of a very short papilla-like joint with two short terminal setae, and a similar seta at its base.

The male of this species resembles the female in general appearance, the differences in the form of the abdomen between the sexes being less than usual. The genital segment (Pl. X, fig. 22) is narrow, a little less than twice as long as wide, the terminal lateral processes not spreading. The three following segments are very short, and the anal segment longer than usual, being nearly as long as wide. The furcal rami are a little shorter than in the female. The principal differences to be noted in the appendages are in the second antenna and the second maxillipede, and in the fourth foot, in which the terminal spine of the endopodite is only half as long as the joint. The terminal joint of the second antenna is scarcely longer than broad, and bears very short curved spines. The second maxillipede (Pl. X, fig. 17) has a pear-shaped second joint, with one slender marginal seta. The upper margin of the second joint is very finely setose, that of the claw being smooth.

Though *Oncaea obscura* does not show any close relationship to any of the already described species, yet it does not possess any marked characteristics; the form of the abdomen, which finds its nearest parallel in *O. tenuimana*, being the feature by which it can most easily be recognised.

It may be useful to draw up a table, taken largely from that of Giesbrecht, of the known females of the genus *Oncaea*, which will include the two species described above.

Occurrence.—Very few specimens of this species were taken in the fine silk nets at 630 and 680 fathoms on Stations S.R. 193 and S.R. 197.

Key to the Females of the Genus *Oncaea*

I. Endopodite of 4th foot with terminal process.

A. 2nd thoracic segment projecting in lateral view, *O. conifera.*

B. 2nd thoracic segment not projecting.

i. 4th thoracic segment pointed, terminal spine of exopodite of swimming feet longer than 3rd joint, *O. dentipes.*

ii. 4th thoracic segment rounded, terminal spine of exopodite of swimming feet shorter than 3rd joint, *O. minuta.*

II. Endopodite of 4th foot without terminal process.
  A. Third joint of 2nd antenna shorter than second.
    i. Furca longer than anal segment.
      a. Furca four times as long as wide.
        1. Body strongly chitinised, purple, *O. venusta.*
        2. Body slightly chitinised, orange or red, *O. mediterranea.*
      b. Furca 2–2½ times as long as wide, *O. media.*
    ii. Furca shorter than anal segment.
      a. Second joint of 2nd antenna serrate.
        1. Genital segment forms half of abdomen, *O. obscura.*
        2. Genital segment forms two-thirds of abdomen, *O. ornata.*
      b Second joint of 2nd antenna smooth.
        1. 5th feet long, directed dorsally, *O. notopus.*
        2. 2nd maxillipede very long and slender, *O. tenuimana.*
  B. Third joint of 2nd antenna longer than or equal to second.
    i. Genital segment forms less than half of abdomen.
      a. Genital segment equals 2nd + 3rd abdominal segments, *O. subtilis.*
      b. Genital segment equals 2nd + 3rd + 4th abdominal segments, *O. curvata.*
    ii. Genital segment forms two-thirds of abdomen, *O. exigua.*

GENUS **Conaea,** Giesbrecht.

Conaea rapax, Giesbrecht.

Occurrence.—Taken in small numbers on four stations at depths between 200 and 630 fathoms.

GENUS **Lubbockia,** Claus.

Lubbockia brevis, sp. n

Pl. XI, figs. 1-9.

Female—length ·85 mm.

The cephalon in the single specimen found was somewhat crushed, but appears to be considerably stouter than in *L. squillimana*, and much less pointed anteriorly; it is distinctly separated from the first thoracic segment. The fourth thoracic segment is rounded laterally, and the fifth almost globular.

The abdomen is of four segments, the genital segment showing a faint suture just behind the genital openings. The proportional lengths of the abdominal segments and furca is approximately 11: 4: 3: 4: 7. The furcal rami are four times as long as broad, the furcal setae being missing in my specimen.

The first antenna (Pl. XI, fig. 2) is very short, six-jointed; the proportional lengths of the joints being 8: 6: 8: 4: 3: 4.

The second antenna (Pl. XI, fig. 6) is three-jointed, the third joint (exopodite) being longer than the first and second together (basals) and bearing five terminal claw-like setae, the outermost being longer and more slender than the rest. Possibly one or more terminal setae have been broken off. There is one inner-edge seta situated at the distal third of the joint, and a very minute seta near the middle of the inner edge. The proximal half of the outer edge and part of the face of the joint adjoining is very finely setose.

The form of the mandible and maxilla could not be made out satisfactorily.

The first maxillipede (Pl. XI, fig. 9) seems to be of the same form as in *L. aculeata*.

The second maxillipede (Pl. XI, fig. 5) agrees with *L. minuta* in having no teeth on its second joint such as are found in *L. aculeata* and *L. squillimana*. The terminal claw is of the usual form.

The swimming feet (Pl. XI, figs. 3, 4, 7, 8) agree with those of *L. minuta* in having three outer-edge spines on the third joint of the exopodites of the first and second feet. The jointing of all the swimming feet appears to be complete. The fifth pair of feet do not possess the outer terminal tooth which is found in *L. aculeata* and *L. squillimana*, and of the two terminal spines the outer is equal in length to the joint and not laminate, while the inner is laminate and twice as long.

Male unknown.

This species, while differing noticeably from both *L. aculeata* and *L. squillimana* in form and to a less degree in structure, is linked to them by *L. minuta*, which has the elongate abdomen of the two latter, but the smooth second maxillipede and the three outer-edge exopodite spines of the first and second feet of *L. brevis*.

Occurrence.—One specimen of *L. brevis* was taken in the fine silk net at 630 fathoms on station S.R. 193.

Genus **Corina**, Giesbrecht.

Corina granulosa, Giesbrecht.

Occurrence.—A single specimen was taken at 100 fathoms on station S.R. 164. It measured ·85 mm. in length, the size of the Pacific specimen described by Giesbrecht being ·68 mm.

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EXPLANATION OF PLATES.

All the figures were drawn with the assistance of a *camera lucida*.

PLATE I.

Mimocalanus nudus, gen. et sp. nov.

Fig. 1.—Female, third foot,	.. ×	90
Fig. 2. „ second antenna,	.. ×	110
Fig. 3. „ mandible, palp,	.. ×	133
Fig. 4. „ second maxillipede,	.. ×	133

Mimocalanus cultrifer, sp. n.

Fig. 5.—Female, first antenna,	.. ×	79
Fig. 6. „ dorsal,	.. ×	51
Fig. 7. „ lateral,	.. ×	51
Fig. 8. „ first foot,	.. ×	280
Fig. 9. „ first maxillipede,	.. ×	280

Spinocalanus spinosus, sp. n.

Fig. 10.—Female, spinulation on carapace,	.. ×	300

Oxycalanus spinifer, sp. n.

Fig. 11.—Female, lateral,	.. ×	35
Fig. 12. „ third foot,	.. ×	96
Fig. 13. „ second foot,	.. ×	96
Fig. 14. „ first foot,	.. ×	96
Fig. 15. „ second antenna,	.. ×	99
Fig. 16. „ first maxillipede,	.. ×	243
Fig. 17. „ maxilla,	.. ×	243

PLATE II.

Chiridius gracilis, sp. n.

Fig. 1.—Female, dorsal,	.. ×	26
Fig. 2. „ lateral,	.. ×	26
Fig. 3. „ second foot,	.. ×	100

Gaidius parvispinus, sp. n.

Fig. 4.—Female,	dorsal,	× 18
Fig. 5. ,,	fifth thoracic segment,	× 31
Fig. 6. ,,	first foot,	× 51
Fig. 7. ,,	second foot,	× 45
Fig. 8. ,,	second maxillipede,	× 45

Gaidius affinis, G. O. Sars.

Fig. 9.—Female,	first foot,	× 85
Fig. 10. ,,	second foot,	× 70

Gaidius validus, sp. n.

Fig. 11.—Female,	fifth thoracic segment,	× 25
Fig. 12. ,,	second antenna,	× 37
Fig. 13. ,,	second maxillipede,	× 37
Fig. 14. ,,	maxilla, omitting first inner lobe,	× 55
Fig. 15. ,,	first foot,	× 37
Fig. 16. ,,	second foot,	× 37
Fig. 17. ,,	dorsal,	× 13

Euchirella Wolfendeni, sp. n.

Fig. 18.—Female,	second antenna,	× 45
Fig. 19. ,,	fourth foot,	× 45

Euchirella obtusa (G. O. Sars).

Fig. 20.—Female,	second antenna,	× 48
Fig. 21. ,,	fourth foot,	× 48

Plate III.

Valdiviella insignis, sp. n.

Fig. 1.—Female,	lateral,	× 6·7
Fig. 2. ,,	second foot,	× 36
Fig. 3. ,,	mandible, cutting edge,	× 36
Fig. 4. ,,	first maxillipede,	× 43
Fig. 5. ,,	third foot,	× 36
Fig. 6. ,,	first foot,	× 36

Gaidius notacanthus, G. O. Sars.

Fig. 7.—Male,	fifth feet,	× 36

Euchaeta rubicunda, sp. n.

Fig. 8.—Female,	genital segment, ventral,	× 19
Fig. 9. ,,	genital segment, lateral,	× 19
Fig. 10. ,,	exopodite of second foot,	× 36

Euchaeta Scotti, sp. n.

Fig. 11.—Female,	genital segment, lateral,	× 32
Fig. 12. ,,	exopodite of second foot,	× 36

Euchaeta barbata, Brady.

Fig. 13.—Female,	genital segment, lateral,	× 32
Fig. 14. ,,	exopodite of second foot,	× 36

Euchaeta Sarsi, sp. n.

Fig. 15.—Female,	genital segment, lateral,	× 32
Fig. 16. ,,	exopodite of second foot,	× 36

Euchaeta bisinuata, G. O. Sars.

Fig. 17.—Female,	genital segment, lateral,	× 37
Fig. 18. ,,	exopodite of first foot,	× 31
Fig. 19. ,,	exopodite of second foot,	× 36

Euchaeta quadrata, sp. n.

Fig. 20.—Female, genital segment, lateral, ... × 30
Fig. 21. " exopodite of second foot, ... × 44

Lucicutia lucida, sp. n.

Fig. 22.—Male, fifth feet, ... × 66

Augaptilus facilis, sp. n.

Fig. 23.—Female, fourth foot, ... × 54
Fig. 24. " second maxillipede, ... × 49

Plate IV.

Euchirella obtusa, G. O. Sars.

Fig. 1.—Female, abdomen, lateral, ... × 23
Fig. 2. " dorsal, ... × 14

Euchirella Wolfendeni, sp. n.

Fig. 3.—Female, dorsal, ... × 127

Euchaeta bisinuata, G. O. Sars.

Fig. 4.—Female, lateral, ... × 15·3

Valdiviella insignis, sp. n.

Fig. 5.—Female, maxilla, ... × 57

Chiridiella macrodactyla, G. O. Sars.

Fig. 6.—Female, first foot, ... × 93
Fig. 7. " third foot, ... × 93
Fig. 8. " second foot, ... × 93
Fig. 9. " second maxillipede, ... × 79
Fig. 10. " maxilla, ... × 170
Fig. 11. " second antenna, ... × 93
Fig. 12. " first antenna, ... × 42
Fig. 13. " lateral, ... × 28
Fig. 14. " first maxillipede, ... × 79

Xanthocalanus typicus, T Scott.

Fig. 15.—Female, first maxillipede, ... × 109
Fig. 16. " fifth foot, ... × 117
Fig. 17. " first foot, ... × 76

Xanthocalanus pinguis, Farran.

Fig. 18.—Female, fifth foot, ... × 79

Plate V.

Undinella brevipes, sp. n.

Fig. 1.—Female, lateral, ... × 60
Fig. 2. " rostrum, ... × 253
Fig. 3. " third foot, ... × 133
Fig. 4. " fifth pair of feet, ... × 347

Cephalophanes refulgens, G. O. Sars.

Fig. 5.—Female, lateral, ... × 19
Fig. 6. " second foot, ... × 75
Fig. 7. " fifth pair of feet, ... × 153

Scolecithrix globiceps, sp. n.

Fig. 8.—Female,	first foot,	× 66
Fig. 9. „	second foot,	× 66
Fig. 10. „	maxilla, terminal part,	× 66
Fig. 11. „	second maxillipede,	× 150
Fig. 12. „	first maxillipede,	× 72
Fig. 13. „	dorsal,	× 147
		× 22

Scolecithrix valida, sp. n.

Fig. 14.—Female,	dorsal,	× 25
Fig. 15. „	lateral,	× 19
Fig. 16. „	second foot,	× 66
Fig. 17. „	first foot,	× 87

PLATE VI.

Scolecithrix gracilipes, sp. n.

Fig. 1.—Female,	lateral,	× 32
Fig. 2. „	first foot,	× 91
Fig. 3. „	fifth foot,	× 417
Fig. 4. „	fifth foot, variation,	× 480

Scolecithrix robusta, T. Scott.

Fig. 5.—Female, fifth foot, .. × 273

Scolecithrix echinata, Farran.

Fig. 6.—Female, fifth foot, .. × 417

Scolecithrix valida, sp. n.

Fig. 7.—Female, fifth foot, .. × 273

Scolecithrix globiceps, sp. n.

Fig. 8.—Female, fifth foot, .. × 273

Temoropia mayumbaensis, T. Scott.

Fig. 9.—Female,	fifth foot,	× 293
Fig. 10. „	second maxillipede,	× 293
Fig. 11. „	maxilla,	× 366
Fig. 12. „	first antenna,	× 280
Fig. 13. „	second foot,	× 293
Fig. 14. „	first foot,	× 293
Fig. 15. „	lateral,	× 92

Lucicutia lucida, sp. n.

Fig. 16.—Female,	dorsal,	× 23
Fig. 17.—Male,	first antenna, left,	× 39
Fig. 18. „	abdomen,	× 44
Fig. 19.—Female,	fifth foot,	× 84
Fig. 20. „	first foot,	× 88

Lucicutia longiserrata (Giesbr.).

Fig. 21.—Female,	first foot,	× 92
Fig. 22. „	fifth foot,	× 92

PLATE VII.

Heterorhabdus robustus, sp. n.

Fig. 1.—Female,	dorsal,	× 22
Fig. 2. „	lateral,	× 22
Fig. 3. „	furca,	× 52
Fig. 4. „	left mandible, cutting edge,	× 69
Fig. 5 „	right mandible, cutting edge,	× 69
Fig. 6. „	first maxillipede,	× 52
Fig. 7. „	maxilla, exopodite and endopodite,	× 69
Fig. 8.—Male,	fifth pair of feet,	× 69
Fig. 9.—Female,	fifth foot,	× 69
Fig. 10. „	second foot,	× 52

Haloptilus fons, sp. n.

Fig. 11.—Female, dorsal, × 12
Fig. 12. " fifth foot, × 62
Fig. 13. " mandible, cutting edge, × 64
Fig. 14. " maxilla, × 62
Fig. 15. " abdomen, × 27

Haloptilus tenuis, sp. n.

Fig. 16.—Female, abdomen, × 37
Fig. 17. " cephalon, lateral, × 17
Fig. 18. " dorsal, × 17
Fig. 19. " second antenna, × 46
Fig. 20. " first maxillipede, × 65
Fig. 21. " maxilla, × 84

PLATE VIII.

Augaptilus facilis, sp. n.

Fig. 1.—Female, dorsal, × 16
Fig. 2. " second antenna, × 45
Fig. 3. " first maxillipede, × 64
Fig. 4. " fifth foot, × 72
Fig. 5. " maxilla, × 72
Fig. 6. " mandible, cutting edge, × 120

Augaptilus similis, sp. n.

Fig. 7.—Female, second maxillipede, × 29
Fig. 8. " first maxillipede, × 34
Fig. 9. " maxilla, × 63
Fig. 10. " dorsal, × 11·3
Fig. 11. " second antenna, × 35
Fig. 12. " details of setae, first maxillipede, × 112
Fig. 13. " mandible, cutting edge, × 112
Fig. 14. " fifth foot, × 51

Augaptilus anceps, sp. n.

Fig. 15.—Female, abdomen, × 45
Fig. 16. " dorsal, × 59
Fig. 17. " second antenna, part of exopodite, × 133
Fig. 18. " fifth foot, exopodal spine, × 267
Fig. 19. " maxilla, × 137

Augaptilus horridus, sp. n.

Fig. 20.—Female, cephalon, lateral, × 11

Augaptilus Rattrayi, T. Scott.

Fig. 21.—Female, cephalon, lateral, × 11

Haloptilus tenuis, sp. n.

Fig. 22.—Female, fifth foot, × 79

PLATE IX.

Phyllopus impar, sp. n.

Fig. 1.—Female, dorsal, × 32
Fig. 2. " abdomen, lateral, × 45
Fig. 3.—Male, left fifth foot, × 59
Fig. 4. " right fifth foot, × 59

Phyllopus Helgae, sp. n.

Fig. 5.—Female, abdomen, ventral, × 45
Fig. 6. " dorsal, × 29

Candacia gracilimana, sp. n.

Fig. 7.—Male, fourth foot, third joint of exopodite, × 133
Fig. 8. " third foot, third joint of exopodite, × 133
Fig. 9. " second foot, third joint of exopodite, × 133
Fig. 10. " maxilla, × 203
Fig. 11. " genital segment, × 57
Fig. 12. " first antenna, hinge, × 203
Fig. 13. " first maxillipede, × 69
Fig. 14. " fifth feet, × 139

Candacia rotundata, Wolfenden.

Fig. 15.—Male, fifth feet, ... × 61

Bathypontia elongata, G. O. Sars.

Fig. 16.—Male, first antenna, ... × 26
Fig. 17. „ fifth feet, ... × 44

Plate X.

Paroithona parvula, gen. et sp. nov.

Fig. 1.—Female, dorsal, ... × 157
Fig. 2. „ cephalon, lateral, ... × 157
Fig. 3. „ genital segment and furca,
Fig. 4. „ first antenna,
Fig. 5. „ second antenna, ... × 433
Fig. 6. „ maxilla, ... × 433
Fig. 7. „ first foot, ... × 680
Fig. 8. „ second foot, ... × 433
Fig. 9. „ second maxillipede, ... × 433
Fig. 10. „ mandible, ... × 433
Fig. 11. „ first maxillipede, ... × 433
Fig. 12. „ third foot, ... × 433
Fig. 13. „ fourth foot, ... × 433

Oncaea obscura, sp. n.

Fig. 14.—Female, second antenna, ... × 400
Fig. 15. „ second maxillipede, ... × 400
Fig. 16. „ mandible, ... × 573
Fig. 17.—Male, second maxillipede, ... × 270
Fig. 18.—Female, maxilla, ... × 573
Fig. 19. „ second foot, ... × 280
Fig. 20. „ third foot, endopodite, ... × 400
Fig. 21. „ fourth foot, endopodite, ... × 400
Fig. 22.—Male, abdomen, ... × 253
Fig. 23.—Female, abdomen, ... × 253
Fig. 24. „ first antenna, ... × 270

Oncaea exigua, sp. n.

Fig. 25.—Female, abdomen, ... × 125
Fig. 26. „ dorsal, ... × 72
Fig. 27. „ second antenna, ... × 340
Fig. 28. „ fourth foot, ... × 466
Fig. 29. „ first maxillipede, ... × 466
Fig. 30. „ second maxillipede, ... × 466

Plate XI.

Lubbockia brevis, sp. n.

Fig. 1.—Female, dorsal, ... × 120
Fig. 2. „ second foot, ... × 287
Fig. 3. „ third foot, ... × 287
Fig. 4. „ second maxillipede, ... × 253
Fig. 5. „ second antenna, ... × 287
Fig. 6. „ fourth foot, ... × 287
Fig. 7. „ first foot, ... × 287
Fig. 8. „ first maxillipede, ... × 287

Oncaea exigua, sp. n.

Fig. 9.—Female, second foot, ... × 467
Fig. 10. „ first foot, ... × 467
Fig. 11. „ third foot, ... × 467

APPENDIX, No. III.

PRELIMINARY REPORT ON THE SIMPLE ASCIDIANS OF THE LARNE DISTRICT.

BY

H. J. BUCHANAN-WOLLASTON.

The Tunicates mentioned in the following paper were all taken within a radius of six miles from the entrance to Larne Lough. The most prolific ground is the loose shelly bottom between Brown's Bay and the Hunter Rock. A few species are very abundant in the Lough.

I have had considerable difficulty in identifying some of the specimens owing to the lack of literature upon the subject. I have had access to very few original descriptions, and have had to identify most of the specimens by means of Herdman's "Revised Classification," in which the diagnoses are necessarily very short.

I have adopted the arrangement and nomenclature given in Herdman's "Revised Classification of the Tunicata" (*J. Linn. Soc., Zool.*, vol. XXIII.)

The following twenty-one species have been obtained in the district:—

Eugyra glutinans.
Molgula simplex.
M. echinosiphonica.
M. roscovita.
Cynthia echinata.
Forbesella tesselata.
Styelopsis grossularia.
Polycarpa glomerata.
P. comata.
P. comata, v. *nux.*
P. pomaria.
Corella parallelogramma.
Ascidiella venosa.
A. aspersa.
Ascidia mentula.
A. plebeia.
A. depressa.
Ciona intestinalis.
Perophora Listeri.
Clavelina lepadiformis.
C. Savigniana.

The measurements given are the averages of full-grown and well-developed specimens, except where the contrary is stated.

ASCIDIAE SIMPLICES.

FAM. *MOLGULIDAE.*

Molgula simplex, A. and H.

This species is common attached to shells, hydroids, &c. dredged from the loose shelly bottom, off Brown's Bay, Island Magee, 10 to 20 fathoms; size, $1\frac{1}{4}'' \times \frac{5}{6}'' \times \frac{5}{6}''$.

Irish Records.—

Loughs Strangford and Ballywater (W. Thompson).

Molgula echinosiphonica, Lac.-Duth.

A single specimen of what I take to be this species was dredged firmly attached to a *Laminaria* root, near the old Pier, Island Magee, 3 to 4 fathoms.

New to Ireland.

Molgula roscovita, Lac.-Duth.

Several specimens were dredged off Brown's Bay, 7 fathoms, on a similar bottom to that on which *M. simplex* was found, but nearer the shore. This species is usually covered with small gravel and coarse sand to a much greater depth than is *M. simplex*. In one instance two specimens were taken firmly adhering to one another. All the specimens were unattached. Size, $1\frac{1}{2}'' \times 1'' \times \frac{7}{10}''$.

The specimens agree fairly well with Forbes's *M. oculata*, but the total absence of the characteristic bare patch between the siphons seems sufficient to distinguish them.

New to Ireland.

Eugyra glutinans, Möll.

A few specimens have been dredged from the shelly grounds off Drain's Bay and Brown's Bay. Size, $\frac{1}{3}''$, globular.

Irish Records.—

(1.) As *Ascidia tubulosa*, Müll., Ballyholme Bay, Co. Down, July, 1846 (Hyndman and W. Thompson).

(2.) As *Molgula tubulosa*.

Strangford Lough, Castle Ward Bay, $\frac{1}{4}$ mile from shore, 7-20 fms., $3\frac{1}{2}$ miles from sea; mud, small stones, gravel (Dickie, *Marine Zool., Strangford L.; Rep. Br. Ass. Adv. Sc.*, 1857).

(3.) Between Maidens Lighthouses and Isle of Muck, about 20 fms., several (Belfast Dredging Committee).

(4.) In a "List of species obtained in Kingstown and Killiney Bays, and a few from Baldoyle." (*Dublin Bay Dredging Committee, Rep. Br. Ass. Adv. Sc.*, 1860.)

Fam. *CYNTHIIDAE.*

Sub.-Fam. *CYNTHIINAE.*

Cynthia echinata (L.).

This species has occurred several times on the shelly ground off Brown's Bay. No large example has been found, those taken being less than $\frac{3}{4}''$ in greatest diameter.

Irish Records.—

Strangford Lough, very rare (Hyndman and W. Thompson).

Forbesella tesselata (Forbes).

This species is common on shells and stones from the Brown's Bay and Drain's Bay grounds, 10 to 20 fathoms. Size, $\frac{1}{8}'' \times \frac{1}{2}'' \times \frac{5}{12}''$.

New to Ireland.

SUB.-FAM. *STYELINAE.*

Styelopsis grossularia, V. Ben.

A very common species on stones from all parts of the district, but more especially from the stony and weedy bottom near the old wooden pier on Island Magee. Those taken range in size from mere specks to $\frac{1}{2}$ inch in greatest diameter.

Irish Records.—

(1.) As *Ascidia rustica* (Thompson, *Nat. Hist., Ireland*), "Commonly investing the larger marine plants—found on shells, stones, &c."

(2.) As *Ascidia grossularia*, Van Ben. "Abundant on shells, stones, and occasionally on Laminariae dredged from a few fathoms' depth on the North-east coast of Ireland" (*loc. cit.*).

(3.) As *Cynthia rustica.* Strangford Lough, common, 4—6 fathoms (W. Thompson and Hyndman).

Polycarpa glomerata (Alder.)

A large colony, encrusting a thick stalk of Laminaria, was dredged in Drain's Bay, 1904. The animals are so crowded that very little of the seaweed is visible.

This species may be readily known by its circle of small atrial tentacles, in a position corresponding to that of the branchial tentacles. Size, $\frac{1}{2}'' \times \frac{1}{3}'' \times \frac{1}{3}''$.

Irish Records.—Some of the records mentioned under *Styelopsis grossularia* may possibly have reference to this species.

Polycarpa comata (Alder).

Many specimens of what may be this species have been dredged on the shelly bottom off Brown's Bay, in 10 to 20 fathoms. They differ from the typical form of *P. comata* as given by Herdman in his "Revised Classification" in that they are firmly attached to fragments of stone or shell, have brown siphons, and have 6-10 internal longitudinal bars on a fold of the branchial sac, 1-3 in the interspace. The typical form is unattached, has siphons yellow speckled with red, and

has 6-9 bars on a fold and 6-8 in the interspace. To the naked eye, the interior of the branchial sac of my specimens is very much like that of a Molgula, the folds of the sac curving round posteriorly to come to a focus at the oesophagus, which is some distance forward dorsally, the dorsal lamina being thus much shortened just as in the Molgulids.

Size with coating of sand, $\frac{7}{8}'' \times 1'' \times 1''$.
Size without coating of sand, $\frac{11}{16}'' \times \frac{1}{2}'' \times \frac{1}{2}''$.

New to Ireland.

Polycarpa comata, v. **nux,** var. nov.

Body unattached, slightly longer than broad when contracted.

Test moderately thick, and of a sub-cartilaginous consistency; prolonged posteriorly into long hair-like processes to which fine sand is attached.

Syphons, completely free from sand, as is also the neighbouring part of the test. They are *very long*, nearly as long as the rest of the body, and in life of a mottled reddish-brown. When expanded they are almost circular, but in partial contraction they are distinctly four-sided.

The *mantle* is fairly thick and opaque.

Musculature consisting (in the body) essentially of a dense inner longitudinal layer and an equally dense outer circular layer, the fibres being apparently absolutely parallel, without crossing one another. The arrangement in the syphons is the same, but not so dense.

Branchial Sac with four well-marked folds on each side. Internal longitudinal bars 8 to 10 on a fold, 1 or 2 in the interspace. The bars are very thin and laminar, and have frilled edges. There are 8 or 9 stigmata in the space meshes. The frilled internal longitudinal bars prevent examination of fold-meshes. The transverse vessels are of two sizes, the intermediate vessels being excessively fine. In some places a third and smaller size of vessel may be seen, crossing part of a mesh.

Endostyle much convoluted, walls delicate, membranous, very thin at the edges.

Dorsal lamina, a very delicate broad membrane with frilled edge; convoluted anteriorly.

Tentacles very long and thin, 30 to 40.

Dorsal tubercle C-shaped, with the aperture between the horns turned to the right (true left), the lower horn slightly turned in.

Gonads few and large, or small and numerous polycarps of a pinkish-yellow colour.

Oesophagus moderately far back, opening large, left lip (true right) delicate, distended, pad-like, right lip formed by the dorsal lamina, here an excessively thin membrane.

Stomach bright dark olive-green, of a long oval shape, deeply longitudinally sulcated. First part of intestine same colour as stomach, large, with a strongly marked typhlosole.

Size of animal (partially contracted), $\frac{1}{2}'' \times \frac{5}{16}'' \times \frac{5}{16}''$.

Compared with the typical form of *P. comata*, it was found that although of a much smaller size, this variety has the syphons about twice as long, internal longitudinal membranes twice as broad, stigmata nearly twice the length, and the dorsal lamina and endostylar laminae much broader and thinner than in the typical form.

Four specimens of this new variety were dredged among gravel and shells in about 7 to 10 fathoms, about $\frac{1}{2}$ mile to 1 mile N. of Brown's Bay, Island Magee. When first taken, they are about the same size as and of a similar appearance to *Eugyra glutinans*, but their long syphons readily distinguish them when allowed to expand in sea-water.

Polycarpa pomaria (Sav.).

This species is very common off Brown's Bay and Drain's Bay in 7 to 20 fathoms, attached to stones and shells. It also occurs of small size near Ritchie's Pier on Island Magee in about 2 fathoms.

Size, $2\frac{3}{4}'' \times 1\frac{1}{4}'' \times 1''$.

The following Irish records may refer to this species :—

(1.) W. Thompson. *Natural History of Ireland. Cynthia microcosmus* (Sav.), N.E. and W. of Ireland.

(2.) Thompson and Hyndman. *On the Marine Zoology of Strangford Lough, &c.*

Cynthia microcosmus, common, 4 to 6 fathoms.

Fam. *ASCIDIIDAE.*

Sub.-Fam. *CORELLINAE.*

Corella parallelogramma (O.F.M.).

Very common on the loose bottom off Brown's Bay, Island Magee, and on a similar bottom near Drain's Bay, in 7 to 20 fathoms. The size ranges from mere transparent specks to $1\frac{3}{4}'' \times 1\frac{1}{4}'' \times \frac{5}{8}''$.

Irish Records.—

On Algae, Strangford Lough (Thompson, *Nat. Hist., I.*).
On shells, Strangford Lough (Thomp. and Hynd.).

Sub.-Fam. *ASCIDIINAE.*

Ascidiella venosa (O.F.M.).

Several specimens of this species have been dredged, attached to stones and shells from the loose ground off Brown's Bay.

Irish Records.—

Size, $1\frac{9}{16}'' \times 1'' \times \frac{7}{16}''$.
Strangford and Belfast Loughs (Thompson, *Nat. Hist., I.*).

Ascidiella aspersa (O.F.M.).

A. scabra (O.F.M.).
A. virginea (O.F.M.).

Let us consider the means of distinguishing the two species *A. virginea* and *A. scabra*. The one character upon which specific distinction is founded is the condition of the dorsal lamina—toothed at the margin or plain. Now in all species of *Ascidiella* that I know of the lamina is ribbed, in strongly marked examples the ribs being carried beyond the margin as teeth; so that the difference of condition of the margin is only a variation in degree and not in kind. The only other well-marked character in which typical specimens of *A. virginea* differ from *A. scabra* is the area of attachment, *A. virginea* being attached by a small area and standing nearly upright, *A. scabra* being attached by nearly the whole of the left side. I have examined a great many specimens of Ascidiidae from both shallow and deep water, and in nearly every case those from deep water are the more nearly upright. So this character does not appear sufficient for specific distinction.

As to *A. aspersa* and *A. scabra*, the distinctive specific characters are given by Herdman as follows :—

(*a.*) Attached by small area, branchial lobes denticulated, about 5 stigmata in a mesh . . . . *A. aspersa*, O.F.M.

(*b.*) Attached by whole left side, branchial lobes rounded, from 7-12 stigmata in a mesh . . . . *A. scabra*, O.F.M.

I collected about a hundred specimens off an old schooner that was lying at the Shipyard Quay, Larne Harbour, last year, some of which looked like *A. aspersa* and some like *A. scabra*. I picked out six specimens which seemed to present grades of variation from one extreme to the other. The following is the description as far as it applies to the above-mentioned characters :—

Attachment.—(1) By rather less than the posterior half of the left side. (2) By much less than the posterior half of left side, the fore-end being much raised. (3) By rather more than posterior half of left side. (4) By left and ventral corner, embracing an area greater than $\frac{1}{3}$ of left side. (5) Attached in a similar way. (6) Attached similarly but by larger area.

The raised fore-ends of (1) and (2) are much longer than those of (4), (5) and (6). No. (3) is intermediate. Attaching-rootlets of test are most developed on (1), (2), (4), (5). In (2) the test is coarsely papillated over a large area, in all the others it is more or less papillated round the apertures.

Branchial lobes well-developed and acutely keeled and toothed in (1) and (2), intermediate in (3), slight and rounded in (4), (5), and (6).

Stigmata (1, 2, 3) about 12 in a mesh.
(4, 5, 6) ,, 16-20 in a mesh.

The three characters given for specific distinction are, then, very variable. I shall, then, in future regard *A. virginea* and *A. scabra* as varieties of *A. aspersa*.

Distribution in District.—

A. aspersa (O.F.M.) v. *triangularis* (Herdman).

Common on shells and stones dredged off the Brown's Bay ground in 10 to 20 fathoms.

A. aspersa, O.F.M., v. *virginea.*

As last.

Irish Records.—

North and N.E. Ireland (Thompson, *Nat. Hist.*, *I.*).

Ascidiella aspersa, O.F.M. (typical form).

Many specimens were obtained from the bottom of a schooner lying at the Shipyard Quay, Larne Harbour, for repairs. They were of considerable size, the largest taken measuring $3'' \times 1\frac{3}{10}'' \times 1\frac{1}{3}''$.

Irish Records.—Strangford Lough (Thompson, *Nat. Hist.*, *I.*).

Ascidiella aspersa, O.F.M., v. *scabra.*

This is the commonest Ascidian of the district. The weed and stones near and just below low-water mark in many parts of the Lough are almost covered with it. It is especially abundant near Magheramorne and in the Bay between the Quay, Larne Harbour, and the Curran. The old schooner mentioned above had many hundred specimens on her bottom. I fertilized and succeeded in hatching the eggs of this variety. The young lived in a bottle from 14th June, 1905, till 5th February, 1906. When the bottom of the bottle became coated with dust the young ascidians grew stalks. This fact suggests the reason of the stalked examples of ascidians sometimes found.

Irish Records.—

"As last. Possibly not distinct from it" (Thompson, *Nat. Hist.*, *I.*).

Ascidia mentula (O.F.M.)

Var. 1,—**ruberrima** (Garstang).

Form β,—**depressa.**

Numbers of this variety have been taken near Magheramorne, in shallow water, lying on the surface of the masses of seaweed, chiefly zostera, which have accumulated under the Quay. It has also been dredged attached to fragments of weed. Hundreds of specimens were found attached to the old schooner I have mentioned above, which was lying off Magheramorne during the winter of 1904. Some of the specimens reached a length of between 6 and 7 inches, the shape being often regularly pyriform, very much longer than broad. In the larger examples the atrial aperture is directed posteriorly. A "pharyngo-cloacal slit" is often present.

Var. 2,—**rubrotincta** (Garstang).

Form α,—**erecta.**

Fairly common attached to stones and shells, dredged from the Brown's Bay ground, in 8 to 15 fathoms.

Var. 3,—**rava** (Garstang).

Form α,—**erecta.**

As last. The colour in life is greenish, translucent, not yellow.

Irish Records.—

Var. *ruberrima-depressa.* At extreme low tides, Portaferry, Strangford Lough, 1869 (Norman).

Bertrabuy Bay, Connemara (A. G. More).

Variety not stated.

Strangford Lough, abundant, 4-6 fathoms (Thompson and Hyndman).

Ascidia plebeia (Alder).

Common on stones and shells in Drain's Bay and on the Brown's Bay ground, 7 to 20 fms. This species is very variable, specimens having one or both syphons enormously elongated being constantly taken. I have taken several specimens agreeing exactly with Alder's *A. producta*, which I consider a variety of this species.

Irish Records.—

Var. *producta.* Extreme low-water. Strangford Lough (Norman).

Ascidia depressa (Alder).

Some specimens of what may be this species have been taken in same situations as *A. plebeia*. Several had *nine* lobes and nine red ocelli round the branchial aperture. The tests of some specimens were crowded with green veins. "Oesophageal languets" are sometimes present. On reaching the oesophageal opening the ribs of the dorsal lamina break away and appear as languets bending over the oesophagus from the left side (true right). The branchial and atrial apertures are very inconspicuous.

Many of my specimens were mature, the vas deferens being crowded with spermatozoa and the oviduct with pink eggs.

In both this species and the last the renal vesicles are usually exceedingly abundant, covering the greater part of the left side of the mantle.

New to Ireland (?).

SUB-FAM. *CIONINAE* (Roule).

Ciona intestinalis (L.)

Common under the Quay at Magheramorne, lying on the surface of vegetable débris; on seaweed from Division G, Larne Lough; attached to stones and shells from deep water (7 to 20 fms.) off Brown's Bay. In the first two localities var. *canina* is the commoner, while off Brown's Bay the greenish transparent form is more usually met with.

Irish Records.—

Strangford Lough, as *A. canina* and *A. intestinalis* (Thompson and Hyndman).

Clew Bay, Co. Mayo (W. T.).

FAM. *CLAVELINIDAE*.

Clavelina lepadiformis (O.F.M.).

Several colonies have been taken in the dredge from Div. J, Larne Lough. I have never found it on the shore.

Irish Records.—

Strangford Lough (W. T.).

Clavelina savigniana (M.-Edw.).

Present in large colonies in two pools at about high water mark, among the rocks between Skernaghan Point and Port Muck. They seem to die off during the winter, and do not

appear again till late spring. The animals have distinct peduncles, and are of a greenish colour with white lines on the "thorax." The stomach is much smaller than in *C. lepadiformis.*

New to Ireland.

Perophora Listeri (Wiegm.).

Common on loose ground off Brown's Bay 10-20 fms., attached to *Polycarpa pomaria*, and Hydroids and Polyzoans.

THE BOTTOM DEPOSITS OF LARNE LOUGH.

BY

Geo. C. Gough, A.R.C.Sc., B.Sc., F.G.S.

Map.

Larne Lough is a land-locked arm of the sea on the north-east coast of Ireland, Larne being about twenty miles from Belfast. The Lough is about six miles long and is roughly one and a half miles at its broadest point; the entrance, however, is narrow, and less than a quarter of a mile wide. Running down at the east side at its upper end is a deeper channel which gives passage to vessels going up to Magheramorne, but its greatest depth is only twenty-seven feet. A large portion of the Lough is uncovered at low water, and hence the bottom is to a great extent covered with plant life of various kinds and especially Zostera. The Lough is on the edge of the basaltic escarpment, and is generally believed to be due to a fault plane, several undoubted faults running parallel to it down the length of Islandmagee.

The escarpment rises fairly abruptly to a height of about 500 feet through the following formations placed in descending order :—

Basalt (Tertiary).
Cretaceous.
Lias.
Trias.

The Lias and Trias form a fairly gradual slope to the water's edge. Several streams empty their water into the Lough, but none of them are large enough to greatly affect the specific gravity of the water except immediately at their entrance. On the Islandmagee side the ground rises less abruptly to a height of about 240 feet.

The Lough has been divided by the Ulster Fisheries and Biology Association into divisions which are more or less arbitrary and do not necessarily coincide with natural divisions. They are shown in the accompanying map and are labelled A.-P.

The material used in this investigation was collected from the Association's steam launch *Mysis* in a medium-sized dredge into which had been placed a piece of sacking. The material was then taken to the laboratory and sifted according to the method described by Allen in the Journal of the Marine Biological Association (Plymouth), Vol. V., the sieves being of the sizes used by him.

Fisheries, Ireland, Sci. Invest., 1906, *IV*, [*Published, December*, 1906].

The method may be summarized as follows, fuller particulars being given in the paper quoted.

The sieves used numbered 6, No. I. having holes of 15 mm., No. VI. having holes of ·5 mm. diameter, the material remaining in each being classified thus :—

I. Stones.
II. Coarse gravel.
III. Medium gravel.
IV. Fine gravel.
V. Coarse sand.
VI. Medium sand.

The material which passes through sieve VI. is stirred up with sea-water and allowed to settle one minute. The material which falls to the bottom in that time is called *Fine sand* and numbered VII., while that which remains in suspension is numbered VIII. and called *Silt*.

Allen found it best to put his material in small quantities at a time in Sieve VI., and to thoroughly wash that, but, after trying various ways, I found it best to use one of the coarser-meshed sieves first, especially as such a lot of weed was mixed with my material, so that most of my dredgings were washed through the sieves in the order of their numbers. Most of the Larne material left nothing in Sieves I.-III. except Zostera, and for that reason I used varying quantities of the material, larger quantities being used when the contents of the dredge were coarse, so that the percentage of error would remain about the same. The method, however, is only approximately accurate, as so much depends on the chance of angular fragments falling into holes lengthways or crossways, and the decanting after one minute, even though repeated several times, as I did, allows margin for error. The contents of the sieves were dried at about 90°C.—in the case of VII. and VIII. first filtered through a weighed filter paper—weighed, and the percentage calculated. A conventional way of finding the "average grade" of each sample was to multiply the percentage by the number of the sieve, add the figures for each sieve together, and divide by 100.

The material in the various sieves I examined with a hand lens, but numbers VII. and VIII., *i.e.*, the Fine Sand and Silt were examined under the microscope and the commoner minerals and organisms determined. A special examination was made of the Foraminifera, but a more complete list is given in my paper on the Foraminifera of Larne Lough.[1] The Silt is by far the most interesting material, because it, no doubt, as Allen remarks, supplies the food for a large number of the smaller animals.

In the material I examined, this contained a large amount of organic matter, chiefly plant debris, but it included small

[1] *Fisheries, Ireland, Sci. Invest.*, 1905, *III.* [1906].

foraminifera, diatoms and sponge spicules. The latter were usually in large numbers, while the quantity of the diatoms varied very greatly but was never very large. Coccoliths I especially searched for, but they were the exception, being only found in one or two samples. The inorganic material was chiefly quartz and felspar, but occasionally specimens of various other minerals were found. The minerals in the Fine Sand were mostly angular fragments of quartz with felspars, but there was often a fair amount of hornblende and augite in some of the samples. Other minerals noted were Olivine, Serpentine, Tourmaline, Apatite, &c.

In the various sieves the materials found were mostly local pebbles and stones such as basalt, chalk, &c., together with the shells, broken and entire, of various mollusca, but in division D. specimens of rocks foreign to the locality were found. Several of these were recognisable, such as the quartz-porphyry from Cushendall; the mica schist from the N.E. of Ireland, &c. While there is no doubt in my own mind that these are true erratics yet a difficulty arises from the fact that in the old days of sailing-vessels, these used to empty their ballast into the Lough, so that these stones may have arrived in their present position in this manner. A grey granite found in fair quantity is one of the hauls is more likely to have been so deposited as the nearest similar granite *in situ* is at Castlewellan, Co. Down.

The details of each division follow :—

A.—Off Salt Co.'s Sheds—Mud, mixed with Zostera.

Sieve		
I., II., III.	Decomposing zostera.[1]	
IV.	Decomposing zostera, worm tubes, and small mollusca,	·35 %
V.	As in IV., tubes form greater part,	·7 %
VI.	Plant fragments, shell fragments, foraminifera, and small mollusca,	·35 %
VII.	Angular and sub-angular fragments of quartz with fair amount of felspar, hornblende, augite, and serpentine,	89·86 %
VIII.	Small amount of debris, few spicules, many diatoms, and much organic matter,	8·74 %

"Average grade," 7·06.

Foraminifera.—The majority of specimens consist of *Rotalia beccarii*, *Polystomella crispa*, *Verneuilina polystropha*, and *Miliolina seminulum*, but small numbers of the following were also found :—*Miliolina tricarinata*, *M. oblonga*, *M. subrotunda*, *M. circularis*, *Cornuspira involvens*, *Haplophragmium canariense*, *Bulimina elongata*, *B. aculeata*, *B. marginata*, *B. elegantissima*, *Bolivina punctata*, *Bolivina plicata*, *Cassidulina laevigata*, *C. crassa*, *Lagena globosa*, *L. laevis*, *L. william-*

[1] Where no number is put there was not enough material to weigh.

soni, *L. semistriata*, *L. squamosa*, *L. quadricostulata*, *Patellina corrugata*, *Planorbulina mediterranensis*, *Truncatulina lobatula*, *Nonionina depressula*, *N. umbilicatula*, *Polystomella striato-punctata*.

B.—Contents of dredge like A.

Sieve

III.	Small mollusca, shell fragments, and decomposing zostera,	2·05 %
IV.	Shell fragments and a large number of gastropods, mostly broken,	1·02 %
V.	Shell fragments, fair number of gastropods, and a few foraminifera,	1·02 %
VI.	As in V., but few gastropods and a large number of foraminifera, chiefly Rotalia,	1·03 %
VII.	Very like A. VII., but less ferro-magnesian mineral,	87·18 %
VIII.	Few diatoms and spicules, a little detritus and much organic matter,.	7·7 %

"Average grade," 6·92.

Foraminifera.—As in A, the four commonest species were *Rotalia beccarii*, *Polystomella crispa*, *Verneuilina polystropha*, and *Miliolina seminulum*, by far the greater number being Rotalia. A good number of *Nonionina depressula* was present, and specimens of the following were found in more or less relative abundance:—*Haplophragmium canariense*, *Bolivina plicata*, *Lagena laevis*, *L. semi-striata*, *L. lucida*, *Truncatulina lobatula*, and *Polystomella striato-punctata*.

C.—Mud.

Sieve

V.	Zostera, &c.	
VI.	Zostera and a few ostracods.	
VII.	Mostly angular and sub-angular quartz with felspar, olivine, augite, serpentine, &c.,	69·23 %
VIII.	Diatoms (frequent (f.)), spicules (f.), coccoliths (rare (r.)), foraminifera (r.), a little detritus mostly quartz, but including some tourmaline and apatite, and much organic matter,	30·77 %

"Average grade," 7·3.

Foraminifera.—Very few specimens were found and these chiefly small ones. A small number of *Globigerina bulloides* and *Nonionina depressula* constituted the bulk, but *Cornuspira involvens* and *Lagena orbignyana* were also found.

D.—Mud and Stones.

Sieve		
I.	Sub-angular pieces of basalt, grey granite, and quartz felsite,	73·8 %
II.	Pebbles of above, with mica-schist, shell fragments, and small mollusca,	10·86 %
III.	Smaller fragments of II.,	·2 %
IV.	One or two fragments, plant debris, &c.,	·1 %
V.	As in IV.,	·1 %
VI.	Fragments, &c., foraminifera, chiefly *Verneuilina polystropha*, and ostracods,	·1 %
VII.	Angular and sub-angular grains of quartz and felspar, much augite,	14·14 %
VIII.	Mostly organic matter with a little detritus, &c.,	·7 %

"Average grade," 2·02.

Foraminifera.—Very few altogether, *Verneuilina polystropha* forming the bulk. Next in quantity was *Haplophragmium canariense*, but only a few were present. Only three or four specimens of the following were found :—*Rotalia beccarii*, *Miliolina seminulum* and one specimen of *Polystomella striato-punctata*. It is interesting to note the relative abundance of arenaceous forms in this section where there is very coarse material, for as a whole the Lough is poor in arenaceous species.

E.—Mud with Zostera, &c.

Sieve		
V.	Fragments of zostera and a few foraminifera.	
VI.	As V.,	·56 %
VII.	Large percentage of ferro-magnesian minerals, but chiefly angular quartz,	62·78 %
VIII.	Diatoms and sponge spicules very rare, a little detritus and much organic matter,	36·66 %

"Average grade," 7·36.

Foraminifera.—The larger specimens, for example those in Sieve VI., consist almost entirely of *Rotalia beccarii* and *Verneuilina polystropha* with a small number of *Polystomella crispa* and *Miliolina seminulum*. The smaller specimens largely consist of *Nonionina depressula* with a smaller proportion of *Lagena globosa*. Other foraminifera found in small numbers included *Miliolina secans*, *Opthalmidium carinatum*, *Bolivina plicata*, *Lagena orbignyana*, *Patellina corrugata*, *Polystomella striato-punctata*.

Sieve

F.—Mud, with Zostera, &c.

V.	Zostera with a few foraminifera, ostracods, and small mollusca,	·93 %
VI.	As V., but with a little detritus,	·92 %
VII.	Mostly quartz, but other minerals and much organic matter,	87·04 %
VIII.	Very fine detritus, few spicules, and much organic matter,	11·11 %

"Average grade," 7·08.

FORAMINIFERA.—Extremely few specimens were found, the larger being *Rotalia beccarii* and *Polystomella crispa*, but also including *Miliolina seminulum*, *M. secans*, *M. bicornis*, and *Truncatulina lobatula*. The smaller ones were mainly of *Opthalmidium carinatum* and *Lagena globosa* with examples, often solitary, of *Cornuspira involvens*, *Lagena laevis*, *L. squamosa*, *L. orbignyana*, *Globigerina bulloides*, *Nonionina depressula*, and *Polystomella striato-punctata*.

Sieve

G.—Rather Sandy.

IV.	Shells of fragments, very little detritus,	·67 %
V.	Mostly fragments, a few bivalves and foraminifera,	·34 %
VI.	Fragments, foraminifera, bivalves, and detritus,	1·68 %
VII.	Nearly all sub-angular or rounded grains of quartz, very little augite or other mineral,	95·62 %
VIII.	Diatoms and spicules frequent, much organic matter, but little detritus,	1·68 %

"Average grade," 6·97.

FORAMINIFERA.—By far the greater number were small, only a few specimens of *Rotalia beccarii* and *Polystomella crispa* being found. The most interesting feature was the comparatively large number of species and the small number of individuals in most cases. These included *Miliolina subrotunda*, *Opthalmidium carinatum*, *Cornuspira involvens*, *Haplophagmium canariense*, *Bulimina fusiformis*, *Bolivina punctata*, *B. plicata*, *B. difformis*, *Cassidulina laevigata*, *C. crassa*, *Lagena globosa*, *L. laevis*, *L. lineata*, *L. williamsoni*, *L. costata*, *L. squamosa*, *L. lucida*, *L. marginata*, *L. orbignyana*, *Globigerina bulloides*, *Patellina corrugata*, *Discorbina globularis*, *D. rosacea*, *Nonionina depressula*. *N. turgida*.

H.

Most of H. is uncovered at low tide. In many parts it is so covered with zostera, ulva, &c., that the dredge brings up no "bottom."

Sieve

VI.	Plant debris and two or three *Rotalias*.	
VII.	Very fine detritus (quartz and felspar) and much organic matter,	66·37 %
VIII.	Spicules and diatoms fairly plentiful, detritus and orgauic matter abundant,	36·63 %

"Average grade," 7·33.

FORAMINIFERA.—These were very sparse, the common ones being *Rotalia beccarii*, *Polystomella crispa*, *P. striato-punctata*, and *Nonionina depressula*; even the first-named, so abundant in most parts of the Lough, being rare. Other species noted were *Miliolina seminulum*, *M. subrotunda*, *Planispirina celata*, *Cornuspira involvens*, *Trochammina ochracea*, *Lagena globosa*, *L. squamosa*, *Globigerina bulloides*, *Patellina corrugata*, *Discorbina globularis*.

J.—*A Thoroughly Stony Deposit.*

Sieve

I.	Basalt, sandstone, &c.,	57·96 %
II.	Stones, shells, and fragments,	10·52 %
III.	As II., with detritus of quartz, flint and basalt,	6·71 %
IV.	As in III., with a few foraminifera,	6·96 %
V.	Detritus with a large percentage of shell fragments, large foraminifera, aud small bivalves,	3·90 %
VI.	Very much as in V.,	1·66 %
VII.	Rounded and sub-angular quartz grains, with augite and olivine and organic matter,	10·24 %
VIII.	Sponge spicules, diatoms in fair amount, detritus and organic matter plentiful,	2·05 %

"Average grade," 2·44.

FORAMINIFERA.—This is by far the best ground for this order in the Lough. In a previous paper[1] I have recorded eighty-eight species from this section. The most abundant are *Miliolina seminulum*, *Bolivina difformis*, *Cassidulina crassa*, *Lagena williamsoni*, *Globigerina bulloides*, *Discorbina globularis*, *D. rosacea*, *Truncatulina lobatula*, *Rotalia beccarii*, *Nonionina depressula*, and *Polystomella crispa*.

K.—*Sandy.*

Sieve

II.-V.	Shell fragments, one or two foraminifera, and small mollusca,	·28 %
VI.	Foraminifera, small mollusca shell and fragments,	·28 %
VII.	Chiefly sharp angular sand, mostly quartz, but a little augite, little calcareous material,	99·16 %
VIII.	Largely plant debris, very little detritus, spicules or diatoms,	·28 %

"Average grade," 6·99.

[1] *Loc cit.*

FORAMINIFERA.—This is almost as good as J. for foraminifera, a large number of species being present. *Miliolina seminulum* is a striking feature of the floatings and is very common. Other common species are *Rotalia beccarii*, *Truncatulina lobatula*, *Polystomella crispa*, *Miliolina bicornis*, and *Nonionina depressula*. Less common are *Miliolina circularis*, *Spiroplecta sagittula*, *Verneuilina polystropha*, *Bulimina elongata*, *B. marginata*, *Lagena globosa*, *Globigerina bulloides*, *Patellina corrugata*, *Discorbina globularis*, and *D. rosacea*.

L.—Large amount of Zostera and Ulva, most of which was removed.

Sieve		
I.	Pecten and cardium shells, stones (basalt, coal, &c.),	7·98 %
II.	Stones (flint, basalt, coal), cardium fragments, &c.,	9·54 %
III.	As in II., with small mollusca,	1·14 %
IV.	As III., but especially bivalves and ostracods,	·63 %
V.	Detritus, small mollusca, chiefly gastropods, and foraminifera,	·39 %
VI.	Chiefly foraminifera with a little detritus,	·39 %
VII.	Rather angular sand, mostly quartz, but hornblende also present; foraminifera frequent, spicules and diatoms rare,	54·41 %
VIII.	A little detritus, very few diatoms and spicules, organic matter plentiful,	25·40 %

"Average grade," 6·2.

FORAMINIFERA.—In Sieves V. and VI. *Rotalia beccarii*, *Verneuilina polystropha*, *Polystomella crispa*, and *Miliolina secans* were plentiful, while a smaller number of *Truncatulina lobatula* and *Miliolina seminulum* were present. In Sieve VII. *Nonionina depressula* and *Polystomella striato-punctata* were present in abundance, with smaller specimens of the above species. Other species noted were *Opthalmidium carinatum*, *Planispirina celata*, *Haplophragmium canariense*, *Trochammina ochracea*, *Lagena williamsoni*, *L. lucida*, *L. obignyana*, *Polymorphina lanceolata*, and *Nonionina umbilicatula*.

M.

Although repeated attempts were made, the dredge did not bring up any "bottom," only Laminaria. M. is quite close to N., and the "bottom" seems practically the same, except that M. to a great extent is covered with Laminaria, while N. is free from it.

N.—*Very Sandy.*

Sieve		
I.	Two or three stones.	
II.	Chiefly lithothamnion, but two or three stones and shell fragments,	2·18 %
III.	Lithothamnion, shell fragments, flint and spirorbis,	·95 %
IV.	Small gastropods, spirorbis, lithothamnion, cinders,	·27 %
V.	Small mollusca, spirorbis, lithothamnion, cinders, and foraminifera,	·55 %
VI.	Shell fragments, foraminifera (*Rotalia beccarii*, *Miliolina secans*, *M. seminulum*, *Truncatulina lobatula*), and detritus, chiefly quartz and flint,	2·04 %
VII.	Mostly sub-angular and rounded fragments of quartz, but with olivine, felspar, &c.,	93·88 %
VIII.	Diatoms (c.), spicules (c.), foraminifera (f.), coccoliths (r.). Much detritus, but little organic matter,	·13 %

"Average grade," 6·81.

FORAMINIFERA.—These were very few in number, and with the exception of *Miliolina bicornis* are enumerated in VI. *Truncatulina lobatula* is the commonest, and the more delicate foraminifera are conspicuous by their absence.

O. (*near Quay*) *Sandy.*

Sieve		
IV.	Worm tubes and small bivalves.	
V.	Plant debris, small mollusca, *Miliolina secans*.	
VI.	As V., with foraminifera,	·37 %
VII.	Angular fragments, mostly quartz, but with felspar, augite, &c.,	97·02 %
VIII.	Little detritus, few spicules and diatoms, and much organic matter,	2·61 %

"Average grade," 7·03.

FORAMINIFERA.—A large number of the more delicate species such as Lagena. Amongst the larger varieties *Truncatulina lobatula* was the most common, but *Miliolina seminulum*, *M. bicornis*, and *Polystomella crispa* were also common, *Rotalia beccarii* being rare. The smaller species included a large number of *Miliolina subrotunda*, *Cornuspira involvens*, *Globigerina bulloides*, *Discorbina globularis*, *Nonionina depressula*, and also specimens of *Biloculina elongata*, *Opthalmidium carinatum*, *Haplophragmium canariense*, *Bulimina marginata*, *Bolivina punctata*, *B. difformis*, *Lagena laevis*, *L. sulcata*, *L. squamosa*, *L. striata*, *L. orbignyana*, *Patellina corrugata*, and *Discorbina rosacea*.

P.—Mud, mostly uncovered at low tide, with stream running down it.

Sieve		
II.-V.	Fragments of weeds, &c.	
VI.	Plant debris, foraminifera (mostly *Rotalia beccarii*), very little detritus, . . .	·29 %
VII.	Chiefly quartz, but also specimens of felspar, augite, serpentine, &c., ...	98·56 %
VIII.	Little detritus, fair number of diatoms, but few spicules, large amount of organic matter, ...	1·15 %

"Average grade," 7·01.

FORAMINIFERA.—The specimens in Sieve VI. were nearly all *Rotalia beccarii*, the exception being a few specimens of *Verneuilina polystropha*, *Miliolina seminulum*, and *Polystomella crispa*. In VII. the common ones were *Nonionina depressula* and *Polystomella striato-punctata*, but the following were also found:—*Miliolina subrotunda*, *Cornuspira involvens*, *Opthalmidium carinatum*, *Haplophragmium canariense*, *Trochammina ochracea*, *Bulimina fusiformis*, *Lagena laevis*, *L. lineata*, *Globigerina bulloides*, and *Nonionina umbilicatula*.

SECOND REPORT ON THE FISHES OF THE IRISH ATLANTIC SLOPE.

BY

E. W. L. Holt and L. W. Byrne.

Plates I–V.

i.—Introductory Notes.

ii.—Scorpaenidae.

iii.—Alepocephalidae.

iv.—Recent additions to the British-and-Irish List.

i.—Introductory Notes.

Many of the fishes which inhabit the deeper water of our Atlantic coast are unfamiliar to fishermen, and are not described in the books to which the general reader has ready access. It is therefore our intention to give an account and figure, or sketch, of all except the well-known kinds. Experience of the amount of time of which we can dispose for work of this sort has made it evident that we must either put out our observations piece-meal or defer them to the Greek Calends, and we therefore propose to publish a note on each family or other group as soon as it is ready. It follows that the notes will appear in no natural systematic order, but this will be a matter of unimportance to readers who are in any sense ichthyologists and of indifference to others. We shall not, in all instances, attempt to define families of fishes, nor, except in the briefest manner, to diagnose genera, since we hope that the general reader will be able to obtain from our figures as much knowledge of the grosser characters of the genus as he may care to possess.

In the citation of synonyms it seems best to adopt no hard and fast rule, for while in some cases it suffices to give references to a few of the principal and most accessible accounts of a species, in others a more or less complete list may be required.

In each successive note we shall endeavour to bring up to date information acquired as to fishes mentioned in previous reports.

Methods of Preservation.—Some remarks made by Koehler (1896), on the action of formaline on the pigments of deep-sea

fishes require attention. With all that he says as to the utility of this preservative in regard to form and tissues we are in complete accord, but he accuses it of destroying the pigments, especially those of dark colour, which last he regards as less assailable by alcohol. Our experience is that weak formaline, say 5 per cent. of the commercial 40 per cent. solution, or about 2 per cent. of formaldehyde, has no more effect on dark fish-pigments than alcohol, and has the further advantage of not dissolving the red and yellow pigments to a very appreciable extent for some considerable period. Exposed to the light these paler pigments rapidly disappear even in formaline; but if the specimens are kept in light-proof vessels, or even wrapped in muslin, the warm colours can be studied with reasonable security some months after preservation, whereas the pigments to which they are due are extracted by alcohol in a few days. Blue colours are usually due to the optical properties of prismatic bodies overlying black chromatophores, and in such cases soon disappear or lose their brilliance in any preserving medium, though the indigo-blue or violet-blue of some deep-sea fishes is fairly permanent. When a blue or greenish-blue colour is due to an actual colouring matter, the latter is rather rapidly extracted by either alcohol or formaline, as in the case of some of the Labridae.

Koehler recommends that after due fixation in formaline, deep-sea fishes should be transferred to alcohol in order to save their dark pigments. Though we think the reason unsound, the advice is undoubtedly good, because formaline may under certain circumstances seriously attack the skeletal tissues, and in general it leaves the fins rather too stiff for easy counting of the rays without rupture of their membranes. In practice we transfer after a few weeks to a mixture of equal parts of alcohol 95 per cent and formaline 5 per cent., but the permanent value of this medium has still to stand the test of time. It must, however, be noted that there are some fishes of which the natural external form is intolerant of alcohol. In the genus *Stomias*, for instance, the body is normally invested by a very definite gelatinous epidermic sheath, which is faithfully preserved by formaline; but even prolonged fixation in that medium will not save this essential part of the natural structure of the fish from immediate shrinkage and opacity on transference to alcohol. Such instances apart, it is well in transferring any fish from formaline to alcohol to observe the same precautions as are requisite in the proper preservation of fresh specimens, viz., successive dehydration in 30 per cent., 50 per cent. and 75 per cent. alcohol; because, as far as our experience goes, the fixation of form by formaline is not always absolute against alteration by strong alcohol.

RECORDS.—In the list of captures by the *Helga* given under each species, it must be understood that when the fishing engine is not mentioned the captures were effected by a beam-trawl of about 32 feet beam. Other nets mentioned were fished chiefly at the depths cited in each case; but, being open nets, they also fished during their descent and ascent. This applies, of course, equally to the trawl, at least during its ascent.

ii.—Fam. *SCORPAENIDAE*.[1]

The British-and-Irish fauna comprises no truly littoral representatives of this family, but three more or less exclusively deep-water species occur regularly within the area. These are *Sebastes marinus*, *Scorpaena cristulata*, and *Scorpaena dactyloptera*. A fourth, *Scorpaena scrofa*, has to our knowledge been occasionally landed at British fishing ports from littoral waters in the Bay of Biscay, and is probably a not infrequent item of the catch of steam trawlers which work the coasts of Portugal and Morocco. It is known to occur in water of 187 fathoms depth, and may possibly range as far north as the southern part of the Irish Atlantic slope. Certain other deep-water *Scorpaenae* at present only known from the slopes of the African and North American plateaux, are not debarred by any known factor of distribution from occurrence within our area. These species are described and in some cases figured, by Lowe (1843–1860), Vaillant (1888), Goode and Bean (1895), Jordan and Evermann (1896–98), and Collett (1896), to whose works reference should be made if Scorpaenids, not mentioned in these notes, should be taken on our coasts.

For purposes of identification the species of *Sebastes* and *Scorpaena* hereinbefore mentioned may be briefly distinguished as follows:—

A. Suborbitals not forming a conspicuous scaleless, superficial ridge. Dorsal fin normally with 15 spines.[2]

Sebastes marinus.

B. Suborbitals forming a more or less conspicuous scaleless, superficial ridge. Dorsal fin normally with 11 or 12 spines.

(i.) Pectoral fins with at least the distal third of their lower rays free from the fin-membrane; suborbital ridges spineless, or with a single small spine. No skinny filaments or lappets on the head or body. No marked depression in the occipital region.[3]

Scorpaena dactyloptera.

[1] See Note added in press, p. 63.

[2] It is as well to remember that the *length* of the spines of the dorsal fin have no value for specific determination unless the size of the individual is taken into account, since the spines decrease in relative length with the growth of the fish. Appreciation of this fact becomes of greater importance in the case of spinous-rayed fishes which attain a huge size (cf. Boulenger, 1907).

[3] The subdivision into several genera of *Scorpaena* adopted by American authors does not appear to us to be justifiable, but we think that there is some ground for treating *Helicolenus* (*i.e.*, in our view *S. dactyloptera*) as a distinct sub-genus, characterised by the free lower pectoral rays, the feebly developed suborbital ridges, and the constant absence of skinny filaments or lappets on the head and scales. Our acquaintance with the majority of other *Scorpaenae* is so slight that we are not prepared to express any opinion as to the propriety of recognising other sub-generic groups.

(ii.) Pectoral fins with all rays connected by membrane throughout; suborbital ridges with several spines or groups of spines; skinny filaments or lappets more or less developed on the head and some of the scales of the body.

(*a*.) A well marked transverse depression in the occipital region; suborbital ridges moderately developed; head and preoperculum scaleless. *Scorpaena scrofa.*

(*b*.) Occipital region without a transverse depression; suborbital ridges strongly developed; sides of head and preoperculum, except upon the bony ridges, scaled.[1] *Scorpaena cristulata.*

In general remark of the distribution of these fishes it may be said that *Sebastes marinus* is primarily an Arctic form which does not, on our side of the Atlantic, range further south than the coasts of Denmark and the north of England. We have no reliable record of its occurrence on any of the western coasts of the British Isles. *Scorpaena dactyloptera* is present on the Atlantic slope from the Canaries to Norway, and has in the North Sea a local *sedes* in the deep hole off Troup Head in Aberdeen, from which place, presumably, young examples have been known to wander as far south as the Humber. *S. cristulata* is known from the Bay of Biscay to the S. W. coast of Ireland, and all three species occur also at suitable depths off the coast of North America. *S. scrofa* has not so far been traced north of the Bay of Biscay as a littoral form, and as a deep-water fish has as yet only been recorded off Madeira and off Cape Spartel in Morocco. *S. scrofa* and *S. dactyloptera* both occur in the Mediterranean.

For culinary purposes *Sebastes marinus* may be said to be about equal to the common sea-bream, *Pagellus centrodontus*, being of good flavour but somewhat dry. *Scorpaena dactyloptera* is also distinctly palatable, and under the name of "red bream" appears to have acquired a recognised status in the London market. Smitt says it is not so good as *S. marinus*. *S. scrofa* is chiefly known to us as an ingredient of the Provençal "bouillabaisse," a confection in which the original flavour of the zoological constituents is wont to be somewhat overpowered by vegetable condiments. *S. cristulata* is as good as *S. dactyloptera*, and larger, but its appearance is uninviting.

Sebastes marinus and *Scorpaena scrofa* being at present unrecorded from the Irish Atlantic slope are not, strictly speaking, within the purview of these notes, but for the sake of completeness we include brief descriptions of them.

[1] Goode and Bean include *S. cristulata* in a group said to have a quadrate occipital pit and scaleless cheeks, whereas their artist, no doubt correctly, delineates the type with scales on its cheeks and no occipital depression, as in our specimens.

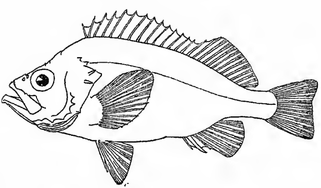
(*SEBASTES MARINUS* L.).

NORWAY HADDOCK (Scotland.)

S. marinus, Smitt (1893), Goode and Bean (1896), Jordan and Evermann (1896-98).

S. norvegicus, Day (1880-1884), (*partim* as to recorded occurrences, some of which refer to *S. dactyloptera*.

S. viviparus, Kröyer (1844-5).



Sebastes marinus, outline after Goode and Bean × $\frac{2}{5}$.

Form somewhat compressed, back arched, ventral outline rather straight. Head about 3 times, or a little less, depth of body about $2\frac{2}{3}$ to 3 times in total length without caudal fin. Eye 3 to $3\frac{1}{2}$ times in head and about as long as snout. Supra-orbital ridges low, armed with two small spines above the orbit and two at their posterior extremity; width between ridges opposite centre of eye rather less than horizontal diameter of orbit; inner ridges (equivalent to inner keel of supra-orbital ridges in *S. dactyloptera*) feeble, widely separate from outer. Inter-orbita- space (that between outer supra-orbital ridges) entirely scale-clad, only slightly concave between inner ridges. Occipital ridges low, diverging, armed with terminal spines. Mouth large, maxilla reaching at least to level of centre of eye; lower jaw projecting. Suborbitals not forming a scaleless projecting ridge and not reaching as far as preopercular margin. Preoperculum with 5 sharp marginal spines; operculum with two sharp depressed spines internal to its upper posterior angle, and a spine on the subopercular bone at its lower posterior angle. Two well marked spines above origin of operculum. Scales small and irregular,

about 75 in a longitudinal series, about 35 with lateral line tubes. D. XV 13-15, its spines strong and sharp, the 4th or 5th the longest, and the last longer than the immediately preceding spine, soft rays in adults longer than spines. A. III 7-9, the second spine stouter but slightly shorter than the third. Pectoral with the rays of its lower half unbranched. Caudal slightly emarginate.

Colour nearly uniform orange or vermilion red, sometimes with ill-defined dusky bars on operculum, back and sides.

Attains a length of at least 1,000 mm.

Though no one who had seen both forms, or who would be at the trouble of counting the dorsal fin rays, could confuse *S. marinus* with *S. dactyloptera*, the two species rather closely resemble each other. They may, however, be at once distinguished by the characters of (i) the interorbital space, broad, and nearly flat in the first-named, narrow and deeply concave in the second; (ii) the sub-orbital ridge, scaled in the first, naked in the second; and (iii) by the difference in the lower rays of the pectoral fin, which are conspicuously detached in *S. dactyloptera*.

An Arctic species of both shores of the Atlantic, apparently usually found in water of over 100 fathoms depth in the southern part of its range. Nowhere common on the British coast and certainly very rare south of the Moray Firth; confusion with *S. dactyloptera* makes it impossible to define its exact range, but it appears never to have occurred in Irish waters.

S. marinus is viviparous; the young have been figured and described by Collett (1880).

We have included Kröyer's *S. viviparus* in the synonomy because the differences which some authors have held to be of specific value appear to be indefinite (cf. Smitt, 1893). It may, however, be quite entitled to rank as a race characterised by darker colouration, smaller size, and, perhaps usually, by a slight difference in the radial formulae. In habitat it seems to be more littoral (occurring commonly between 20 and 60 fathoms), and in horizontal distribution usually more southern than the larger typical race. The few strictly British examples that have come under the observation of one of us certainly belonged to the smaller, darker race, and if the specific distinction of the two be upheld it is probable that only *S. viviparus* ought to be included in the British-and-Irish list. The vernacular name "Norway Haddock" belongs to *S. viviparus*, which, at least usually, has a rather conspicuous black blotch on the operculum; but so far as one of us can recollect the name was also applied at Grimsby to the big orange-red examples of the typical form which became common in that market when the Iceland trawling grounds were opened up (*ca.* 1892).

SCORPAENA DACTYLOPTERA, Delaroche (1809).

Pl. I.

Red Bream.

S. dactyloptera, Günther (1889), Smitt (1893), Holt and Calderwood 1895.

Sebastes dactylopterus, Güuther (1859-70).

Sebastes imperialis, Cuvier aud Valenciennes (1828-49), Lowe (1843-1860).

Helicolenus dactylopterus, and *H. maderensis*, Goode and Bean (1895), Jordan and Evermann (1896-98). [*Not Scorpaena madurensis*, Cuvier and Valenciennes (1828-49), *Sebastes maderensis*, Lowe (1843-1860), Güuther (1859-70), Collett (1896).]

Goode and Bean regarded *S, imperialis*, Lowe, as distinct from *S. imperialis*, C. and V. (which is a synonym of *S. dactyloptera*, Delaroche), and applied to it the name of *H. maderensis*, which was preoccupied in *Scorpaena*. Lowe, himself, as his synonomy and deseription show, regarded his speeies as identical with the *S. dactyloptera* of Delaroehe aud Risso. There is a good series of *S. imperialis* of all sizes, collected by Lowe at Madeira, now in the British Museum; we have examined these, and feel no hesitation in following Lowe and Günther in regarding them as *S. dactyloptera*. There is also in the British Museum a specimen 125 mm. long (105 mm. without caudal fin) received from the Smithsonian Institution as *H. maderensis*, Goode and Bean; we have carefully compared this specimen with *S. dactyloptera* of the same size from both Madeira and the West of Ireland, and can find no trace of the alleged specific differences between the two supposed speeies, the so-called *H. maderensis* being, in fact, a perfectly normal young specimen of *S. dactyloptera*. We can only surmise that Goode and Bean have been misled by looking at Lowe's figure without carefully studying his synonomy and deseription, and by failing to take note of the ordinary changes of form in *S. dactyloptera* in the course of its growth. Their figure, described on the plate and in the text as *H. dactylopterus*, but in their list of plates as *H. maderensis*, is apparently drawn from a half-grown *S. dactyloptera*.

The characters of Irish specimens of *S. dactyloptera* measuring from 78 to 330 mm., without caudal fin, are as follows :—

Form moderately compressed throughout, head not flattened nor laterally expanded. Greatest height of body (at origin of ventral fins) about 3, length of head (without lower jaw) about $2\frac{1}{4}$ to $2\frac{2}{3}$ in total length without caudal fin. Horizontal diameter of orbit from about $2\frac{4}{5}$ in young, to about $3\frac{1}{4}$ in adults, greatest width of body (at shoulders) about 2 in length of head. Length of snout about $1\frac{1}{3}$, width between outer edges of supraorbital ridges from about 3 in young to about $2\frac{1}{2}$ in adults in horizontal diameter of orbit, which is greater than least height of caudal

peduncle. Length of caudal peduncle, measured between base of last dorsal ray and central caudal rays, somewhat greater in young, somewhat loss in adults, than its least height. Length of longest ray of dorsal fin about $1\frac{1}{4}$ in young, about $2\frac{2}{3}$ in large adults (330 mm.) in greatest height of body. Dorsal profile of head descending in a rather even curve from occipital region, snout somewhat humped in adults, with a spine of moderate size on each side. Jaws equal in young, or with the upper slightly projecting; lower jaw slightly projecting in adults. Small, rather stout, curved teeth in bands on the jaws, vomer, and palatines. No teeth on the premaxillary symphysis. Anterior end of tongue free. Maxilla extending at least beyond vertical of hind edge of lens in young, nearly to vertical of hind edge of orbit in adults. Orbit nearly circular in young, considerably longer than high in adults. Supraorbital ridges doubly keeled, with a spine in front, and two or three small spines behind on the inner keel, outer keel terminating behind in a small spine outside origin of occipital ridge. Occipital ridges diverging, with a small terminal spine, and another, obsolete in adults, a little in front of it. Interorbital space narrow, concave, especially in young, and scaleless. Suborbital ridge with or without a single small spine. One or two small spines at insertion of operculum. Operculum with 2, preoperculum with 5 flat spines. Upper or first preopercular spine much shorter than the next or second, which is considerably longer than the remainder, the fourth and fifth reduced to mere serrations in large adults, all the spines rather evenly spaced, or with the third rather near the second. Pectoral and ventral fins reaching beyond anus, occasionally to anal fin, in young, not, or scarcely, reaching anus in adults. Pectoral fin with 18 to 20 rays, the 2 upper slender and spinous, the next 8 to 10 branched, the lower 7 to 9 soft but unbranched, free of membrane as to about their distal thirds, slender in young, all except the uppermost thickened and fleshy in their middle parts, and tapered distally to a rather fine point in adults[1]. Dorsal fin, commencing between verticals from base and tip of second preopercular spine, with 12 rather strong spines, of which the third to fifth are the longest, and 12 branched rays, last spine considerably longer than that immediately proceeding it. Membrane not produced into lappets. Anal fin commencing about opposite second part of dorsal, and at some distance behind anus, with three spines and five branched rays, the third spine almost or completely clothed in membrane[2]. Caudal fin slightly emarginate. Integuments of fins not conspicuously thickened in old examples. Scales finely ctenoid, in about 8 or 9 longitudinal rows above, and about 15 to 18 rows below lateral line in front of anus (exclusive of some small scales on dorsum and ventrum), and in about 50 to

[1] The pectoral fins are frequently asymmetrical either as to the total number of rays or ae to their division into the several categories, *e.g.*, right, 2, 9, 8, left, 2, 9, 7, right, 2, 10, 8, left, 2, 9, 9. In the last case the *two* uppermost eimple eoft rays of the right fin are slender, the lower eight only being thickened.

[2] The spines of this fin are subject to rather frequent abnormality. In a specimen before us the eecond spine is greatly swollen, after the manner apparently normal in *S. cristulata*. As to other abnormalities see Jacquet (*Bull. Mus. Océanogr. Monaco*, No. 79, 1906).

63 transverse rows[1] between head and origin of caudal rays, tho rows usually more or less irregular. Scales present on head, except on bony ridges, interorbital space, snout, jaws, and under side; also present on bases of soft part of dorsal and of caudal fin, and on basal part of pectoral fin. No dermal lappets or filaments on any part of head or body.

General colouration red, shading through rose-pink to white, or yellowish white, on ventrum, with bands of intense scarlet descending from dorsum; fins pink, with scarlet mottlings, margins of median fins white. Black or dark brown pigment, masked during life by red, present in young in position of bands, variable in adults, and when present usually disposed in general mottling of upper parts of head, body, and dorsal fins. Iris bright yellow, lens opalescent in life. Pharynx black or lead-coloured. Size, 450 mm.[2] Female may be fully mature at 210 mm. (without caudal fin).

Measurements in millimetres, and number of Scales and Fin Rays in five Irish specimens.

—	a.	b.	c.	d.	e.
Station (Series S.R.), ...	360	97 B.	97 B.	97 B.	361
Total length, ...	105	180	245	287	410
Total length without caudal fin,	84	139	196	235	330
Length of head without lower jaw,	34	57	77	91	130
Length of snout, ...	8	11	15	21	29
Length of orbit, ...	12	21	27	30	40
Width between supra-orbital ridges,	4	8	10	10	16
Width of body at base of pectoral fin,	10	20	38	46	65
Length of pectoral fin, ...	27	44	54	59	80
Length of ventral fin, ...	21	33	40	45	65
Snout to first dorsal spine, ...	25	50	61	73	97
Snout to anus, ...	50	88	124	150	213
Anus to first anal spine, ...	5	11	15	19	19
Height of head behind eye, ...	22	38	50	61	89
Height of body at origin of ventral fins,	27	47	61	75	117
Height of caudal peduncle, ...	8	15	21	24	34
Length of caudal peduncle from base of dorsal fin to anterior caudal rays,	10	22	22	30	30
Number of scales above lateral line opposite anus,	—	9	9*	8	8*
Number of scales below lateral line opposite anus,	—	62	61	62	62
Number of scales between head and caudal fin,	—	16	16	18	18
Number of dorsal fin-rays, ...	XII. 12	XII. 12	XII. 12	XII. 12	XII. 12
Number of anal fin-rays, ...	III. 5.	III. 5	III. 5	III. 5	III. 5
Number of pectoral fin-rays, left side,	2, 9, 8	2, 8, 9	2, 9, 8	2, 9, 9	2, 9, 8
Number of pectoral fin-rays, right side,	2, 0, 8	2, 9, 8	2, 9, 8	2, 9, 8	2, 9, 7

* Exclusive of some small scales at the dorsum.

1 See *post*, p. 12.

2 *Fide* Smitt.

Length in millimetres, of Dorsal Spines and of longest Soft Ray.

—	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	Ray.
Specimen *c*,	15	23	28	31 *ca.*	27+	27	26	26	22	18	18	24	33
Specimen *e*,	17	37	43	44	43+	40	36	35	27	26	24	30	52

Number of Rays of Pectoral Fins in other specimens from Station S.R. 97 B.

Length of Specimen without Caudal fin.	Left Pectoral fin.	Right Pectoral fin.
212 mm.	2, 9, 8	2, 9, 8
210 mm.	2, 9, 7	2, 9, 8
210 mm.	2, 9, 9	2, 10, 8*
144 mm.	2, 8, 9	2, 9, 8

This specimen has the *two* uppermost of the lower simple rays of the right fin slender.

Our figure is sketched from the largest specimen in our possession, measuring 410 mm. in total length, 330 mm. without the caudal fin. Its other measurements, and those of some smaller specimens, are detailed above, but for rough verification of proportions we have examined twelve specimens, and suppose that, with the necessary allowance for individual variation, the proportions are stated with sufficient exactitude for the range of size to which they are intended to apply. One female, very heavy in roe, has the length of head and height of body relatively somewhat greater than we have stated, but the body is somewhat curved and may have been shrunk by post-mortem changes before preservation. The armature of the head is of course more formidable in young examples than in the old specimen figured; but it is never very much developed, and the cranial and sub-orbital ridges, though always easily seen, are never very stout. An intelligible statement of the scale formula presents great difficulty, for it is not possible to say of the species that its scales are either regular or the reverse, for both conditions occur in specimens from the same haul, especially in the case of the longitudinal rows. Usually in the count of these in a transverse line a little in front of the anus, the enumeration of scales above the lateral line is confused by the presence of more or fewer small irregular scales (which we omit to count) on the dorsum, but sometimes the large scales go right up to the bases of the dorsal fin rays.[1] Below the lateral line all specimens have more or fewer irregular scales on the actual ventrum, but in their extension on to the sides there is

[1] In our figure, Pl. I., the scales are shown diagrammatically. In a correct lateral view the dorsal and ventral scales would be foreshortened.

considerable variety. The transverse rows which cross the lateral line between the head (which we take as terminating at the posterior angle of the operculum) and the origin of the central caudal rays may be, to first glance, apparently regular or obviously irregular, but when one comes to count them they are found to be always more or less confused, so that different observers might easily give counts of apparently important difference. Our record gives the widest range covered by counts made separately by each of us, and is probably sufficient to cover the limits of observation however the count is made. One of us, counting as many as could reasonably be included, obtained a range of 58 to 63; the other counting as few as could reasonably be included, obtained in other specimens a range of 50 to 57; one specimen yielded a count of 52 on one side of the body and 57 on the other. We presume that the numerous authors who give "about 50" as the number have counted on somewhat conservative lines.

Certain authors have enumerated the perforated scales of the lateral line, which we consider to be impossible of exact count without stripping off all the ordinary scales. Smitt gives 26 to 30, no doubt as the result of autopsy; we should personally have been inclined, from a superficial examination only, to put the number somewhat higher.

The actual form of the membrane of the spinous part of the dorsal fin is rather difficult to determine, because the membrane is almost always detached from the back of the tips of the spines, and in that condition looks very much as if it had been, when *in situ*, produced behind the tip of the spine in the form of a lappet. A few of our specimens, however, have the membrane perfect between some of the spines, and its outline is simple, as in our figure. Quite possibly the same is true of some other bathybial species of *Scorpaena* which are credited in literature and art with the possession of dorsal fin lappets.

The colouration which we have noted above varies, according to Messrs. Farran and Kemp, in the distinctness of the transverse bands, some specimens being almost uniform in colour. We have no means of deciding whether or no the more vividly coloured specimens are breeding males, but it is not improbable that this is the case.

We have mentioned above that in young specimens the position of the red bands is defined, after the red pigment has faded, by black chromatophores. In a series measuring from 78 to 99 mm. without the caudal fin, these dark bands are fairly constant. The first is at the shoulders, continuous with practically diffuse dark pigment on the upper parts and sides of the head. The next two are in the form of very crooked wedges, and are succeeded by a V-shaped band from the part of the back occupied by the soft part of the dorsal fin. The last band is on the hinder part of the caudal peduncle. The bands are not continued very definitely on to the dorsal fin, but in a few specimens there is a large blotch of dark pigment occupying the membrane of several of the hinder spines of the spinous portion above the second wedge-shaped band. In older examples before us dark pigment

is very indefinite and never in the form of bars, but in some very fine examples from Troup Head, which one of us had the opportunity of examining soon after their reception at the British Museum, there was a good deal of dark colour in the region of the bars, but in no sense defining their extent as in the case of young fish. Some authors mention brown markings on the bands, which we suppose to be due to post-mortem effects.

A number of very small examples, about 41 to 44 mm. in total length, taken by Mr. W. S. Green in August, 1890, were examined by one of us a few weeks after capture and preservation in undiluted methylated spirits. They then had the bars very conspicuously defined in dark brown pigment, with the dorsal fin blotch extremely well marked in the same colour (Holt and Calderwood, 1895, p. 411). No note of colour was made at the time of capture, but Mr. Green, shortly after the event, had no recollection of their having been red. The specimens are extant, and do not differ much in general proportions from the larger forms which we have used for description. The length of the head, without the lower jaw, is about $2\frac{5}{8}$ to $2\frac{2}{3}$, the height of the body about 3, in the total length without caudal fin, and the length of the orbit about 3 in that of the head. The interorbital space is relatively wide, about $1\frac{1}{3}$ in the length of the orbit, and rather distinctly flatter than in half grown and young adult specimens. The longest dorsal spine is longer than the orbit, and the cephalic spines, especially the second of the preopercular series, are rather formidably developed. All the rays of the pectoral fin are simple, and, so far as can be determined, the lower rays are naturally united by membrane except at the extreme tips. This was also the case in a specimen obtained by one of us from the Humber River in 1893, though the total length was 121 mm.; but in all our Irish material, ranging in total length from about 105 mm. upwards, the lower pectoral rays are certainly separate to a distance which does not seem to vary much in relation to size of individuals.

In a perfect specimen measuring 63 mm. in total length, evidently killed in formaline, the branching of the middle pectoral rays is already accomplished, while the lower rays have the extremities free for about a third of their total length. The pectoral fins are expanded and probably serve to illustrate the extent to which the lower simple rays can be brought into action as ventral tactile organs. The general direction of the fin is at about 45° to the horizontal axis of the body, but the lower simple rays are depressed so that the tips of all of them are well below the ventrum. They are, moreover, somewhat incurved, which may or may not be their natural condition when the fin is expanded. Sundry specimens, preserved after death, show that the fin can be brought forward along the head, in which position the lower rays, if depressible under such circumstances, would seem to have some value as ground-searchers, if one assumes them to exercise a sensory function, as is the case in the corresponding rays of the gurnard.

The specimen referred to, 63 mm. in total length, measures 51 mm. without the caudal fin, the head 21 mm., orbit 8 mm., interorbital a little over 3 mm., height of body 16 mm., least height of caudal peduncle a little under 5 mm., longest dorsal spine a little over 6 mm. The upper jaw projects a little.[1] The dorsal fin blotch and the transverse bands are well defined in black pigment, but there is in addition a rather diffuse dark pigmentation along the middle region of the sides, except on the caudal peduncle. This is the smallest specimen of adult form taken by the *Helga*, and, as to its colouration in life, Messrs. Kemp and Farran consider it must have been red, because knowing the species quite well at all its stages, they have no recollection of ever seeing a specimen that was not red.

Among the larvae in the *Helga* collections we have found a few that appear to us to be of this species, but they are all more or less mangled, and not worthy to be used as evidence of distribution.

Scorpaena dactyloptera has been taken by the *Helga* during the years 1901–1906 at the stations listed below. The measurements of specimens are transcribed from the fishing log and were made only to the nearest centimetre. The first capture recorded is from a long-line station. At all the subsequent stations the captures were made either in the beam-trawl or in fine-meshed nets attached thereto.

Helga, LXXVII.—29-6-'01, Porcupine Bank, 53° 24′ 30″ N., 13° 36′ W., *ca.* 91 fathoms.
One, 16 cm., in mouth of a larger fish.

Helga, CXXI.—24-8-'01.—64 mi. N.W. ½ W. of Cleggan Head, Co. Galway, 199 fathoms.
Four, 19 to 26 cm.

S.R. 97 *B.*—3-5-'04, off Fastnet Lt., Co. Cork, 50° 31′ N., 10° 55 W., 181 fathoms, fine sand.
Ten, 17 to 29 cm., one female with ripe ovaries.

S.R. 169.—4-11-'04, off Tearaght Lt., Co. Kerry, 51° 50′ N., 11° 26′ W., 129 fathoms, fine sand. Temperature 10·3° C.
One, 18 cm.

S.R. 171.—5-11-'04, off Tearaght Lt., 52° 7′ N., 11° 58′ W., 337 fathoms, fine muddy sand.
Fifty-two, 15 to 29 cm.

S.R. 188.—3-2-'05, off Tearaght Lt., 51° 53′ N., 11° 59′ W., 320 to 372 fathoms, mud. Temperature at 300 fathoms, 10·125° C., salinity 35·50 ‰.
Nineteen, 14 to 30 cm.

S.R. 211.—5-5-'05, off Fastnet Lt., 50° 20′ N., 10° 20′ W., 81 fathoms, fine sand. Temperature at 70 fathoms, 10·38° C. salinity 35·30 ‰.
Three, 15 to 18 cm.

[1] In Mr. Green's smaller specimens the lower jaw projects slightly, but this is obviously due to shrinkage of the receptive apparatus of the premaxillae in strong alcohol.

S.R. 212.—6-5-'05, off Tearaght Lt., 51° 54′ N., 11° 57′ W., 411 fathoms, muddy sand. Temperature at 350 fathoms, 9·82° C., salinity 35·28 °/$_{oo}$.
Seven, 16 to 29 cm.

S.F. 215.—9-5-'05, off Tearaght Lt., 52° 01′ N., 11° 21′ W., 107 fathoms, fine sand.
Eighteen, 6 to 19 cm.

S.R. 216.—9-5-'05, 52° 21′ N., 11° 54′ W., 164 fathoms, fine sand.
One, 17 cm.

S.R. 217.—9-5-'05, 52° 44′ N., 12° 30′ W., 208 fathoms, fine sand. Temperature at 200 fathoms, 10·0° C.
Two, 16 and 35 cm.

S.R. 220.—11-5-'05, off Cleggan, 53° 39′ N., 12° 24′ W., 185 fathoms, fine sand and shells.
Eight, 16 to 33 cm.

S.R. 222.—12-5-'05, 53° 01′ N., 14° 34′ W., 293 fathoms, fine sand. Temperature at 100 fathoms, 9·9° C.
Forty-seven, 6·5 to 28 cm.

S.R. 227.—13/14-5-'05, 53° 20′ N., 13° 00′ W., 164 fathoms, fine sand. Temperature at 120 fathoms, 9·5° C.
One, 29 cm.

S.R. 321.—1-5-'06, 50° 56′ N., 11° 17′ W. to 51° 0′ 30″ N., 11° 17′ W., 480 to 208 fathoms, fine sand.
Seven, 18 to 27 cm.

S.R. 329.—9-5-'06, 51° 22′ 30″ N., 11° 31′ W. to 51° 20′ 30″ N. 11° 38′ W., 215 to 415 fathoms. Temperature at 400 fathoms 9·55° C., salinity 35·33 °/$_{oo}$.
Forty-one, 17 to 41 cm.

S.R. 330.—9-5-'06, 51° 18′ 30″ N., 11° 39′ W. to 51° 14′ N., 11° 35′ W., 374 to 415 fathoms, fine sand.
Ten, 19 to 28 cm.

S.R. 338.—13-5-'06.—51° 31′ N., 11° 38′ W. to 51° 26′ N., 11° 40′ 30″ W., 291 to 330 fathoms, mud.
Twenty-four, 21 to 34 cm.

S.R. 351.—5-8-'06, 50° 18′ N., 11° 5′ W. to 50° 21′ N., 11° 7′ W., 230 to 250 fathoms, fine sand. Temperature 10·1° C.
Eighteen, 16 to 28 cm.

S.R. 353.—6-8-'06, 50° 37′ N., 11° 32′ W. to 50° 40′ N., 11° 32′ W., 250–542 fathoms, muddy sand. Temperature at 500 fathoms 8·58° C.
Ten, 2 to 35 cm.

S.R. 360.—8-8-'06, 50° 4′ 30″ N., 11° 25′ W. to 52° 4′ N., 11° 30′ W., 108 to 120 fathoms, fine sand.
Twenty, 9 to 12 cm.

S.R. 361.—8-8-'06, 51° 50′ N., 11° 40′ W. to 51° 49′ N., 11° 45′ W., 177 to 213 fathoms, fine sand.
Eighteen, 16 to 40 cm.

S.R. 362.—9-8-'06, 51° 34′ 30″ N., 11° 25′ W. to 51° 35′ N., 11° 30′ W., 145 to 160 fathoms, fine sand. Temperature at 150 fathoms 10·05° C.
Eight, 11 to 21 cm.

S.R. 365.—10/11-8-'06, 51° 25′ N., 11° 29′ W. to 51° 25′ N., 11° 36′ W., 385 to 440 fathoms. Temperature at 380 fathoms, 9·44° C.
Two, 24 and 27 cm.

S.R. 367.—11-8-'06, 51° 38′ N., 11° 34′ W. to 51° 38′ N., 11° 41′ W., 287 to 332 fathoms, muddy sand.
Three, 24 to 27 cm.

S.R. 379.—1-11-'06, 50° 14′ N., 10° 50′ W. to 50° 14′ N., 10° 57′ W., 126 to 139 fathoms, fine sand and shells. Temperature at 135 fathoms, 10·66° C., salinity 33·60 °/$_{oo}$.
Twenty-five, 7 to 28 cm.

S.R. 380.—1-11-'06, 50° 29′ N., 11° 0′ W. to 50° 32′ N., 11° 0′ W., 142 to 214 fathoms, fine sand.
Eleven, 12 to 20 cm.

S.R. 384.—6-11-'06, 51° 54′ 30″ N., 11° 37′ W., 162 to 218 fathoms, fine sand. Temperature at 200 fathoms, 10·2°C., salinity 35·41 °/$_{oo}$.
Sixteen, 13 to 27 cm.

While the list sets forth the positive results of trawling in so far as concerns this species, the negative results require brief mention. In the years 1901 to 1906, inclusive, the *Helga* made 51 hauls of the 25 or 30 feet beam trawl off the west and south west coasts at depths exceeding 50 fathoms. A detailed analysis of these hauls in regard to locality and season may properly be deferred until we have opportunity of dealing with the whole catches. For present purposes it may suffice to say that the winter hauls are relatively few, viz., 2 in November, 1904, 1 in January, 1905, 1 in February, 1904, 1 in February, 1905, 1 in February, 1906. Summer and autumn hauls are more numerous, viz., 2 in May, 1904, 11 in May, 1905, 13 in May, 1906, 2 in August, 1901, 1 in August, 1903, 2 in August, 1904, 11 in August, 1906. The distribution of the hauls in zones of depth is as follows :—

50 to 100 fathoms.—1 in February, 1904, 2 in January, 1905, 1 in May, 1905.
100 to 200 fathoms.—1 in August, 1901, 1 in August, 1903, 2 in May, 1904, 2 in August, 1904, 1 in November, 1904, 5 in May, 1905, 2 in August. 1906, 1 in November, 1906.
100 + to 200 + fathoms.—1 in August, 1906, 1 in November, 1906.
200 to 300 fathoms.—2 in May, 1905.
200 + to 300 + fathoms.—1 in May, 1906, 2 in August, 1906.
300 to 400 fathoms.—1 in August, 1901, 1 in November, 1904, 1 in February, 1905, 1 in May, 1906.
300 + to 400 + fathoms.—1 in May, 1906, 1 in August, 1906
400 to 500 fathoms.—2 in May, 1905, 1 in August, 1906.

400 + to 500 + fathoms.—1 in May, 1906.
500 to 600 fathoms.—1 in May, 1905, 1 in February, 1906, 2 in May, 1906.
600 to 700 fathoms.—1 in May, 1906, 1 in August, 1906.
600 + to 700 fathoms.—2 in May, 1906, 1 in August, 1906.
200 + to 400 + fathoms.—2 in May, 1906.
200 + to 500 + fathoms.—1 in August, 1906.
400 + to 600 + fathoms.—1 in August, 1906.
500 + to 800 + fathoms.—1 in May, 1906.
600 + to 800 + fathoms.—1 in May, 1906.

The list of captures contains only one record of *S. dactyloptera* between 50 and 100 fathoms, viz, 81 fathoms in May, 1905, but the total number of hauls at this zone of depth is four, of which three were made in winter months. The available data hardly suffice for suggestion of seasonal influence on vertical distribution, or might, indeed, be held to signify a winter shoreward migration (*cf.* Clarke, 1893, Holt, 1893). It appears that adults may occur on the Irish coast at not more than 81 fathoms. The young (p. 14), were taken there in number at 80 fathoms in August, 1891 (Holt and Calderwood, 1895). Two somewhat older examples occurred in February and April, 1893, on the coast of Yorkshire, the first washed ashore on the Coatham Sands, the second taken in the Humber estuary at less than 5 fathoms, but it would be unsafe to cite them as evidence of normal distribution. Indeed, according to the recollection of one of us (unsupported by any extant note), the early part of the year in question was characterised by disturbances which littered the shore of Holderness with lobsters (locally reputed to have come from Norway!) and strewed the Humber margin with young haddock, which have ordinarily no place in that estuary. Vaillant, however, records nine specimens presumably adult, from only 49 fathoms (Cape Verde Islands), and one from 54 fathoms (Spain), so that it would seem not improbable that the species may normally range on our Atlantic coast considerably above the 100-fathom line. Some specimens in the Dublin Museum, captured on the S.W. coast as early as 1843, must have come from no considerable depth.

The lower limit of distribution cannot be taken with certainty from the *Helga* captures beyond 411 fathoms, and the deepest sounding of any station at which specimens occurred is 440 fathoms.[1] Vaillant, however, gives an absolute record (Canary Islands) of 567 fathoms, and there is nothing to show that any part of the haul traversed shallower ground. Only one specimen was then taken, and the nearest station, in point of depth, in the *Travailleur* and *Talisman* list, is 428 fathoms (Soudan).

On the southern part of the coast of Norway *S. dactyloptera* appears to be taken regularly, but not in great number, between

[1]This is modified by the list of captures in 1907, which can only be dealt with here in the form of a note. In September, one occurred between 470 and 491 fath., two between 447 and 515 fath., thirty-three between 346 and 400 fath. In May, thirty-four were taken between 221 and 341 fath., four between 343 and 346 fath., and four between 350 and 389 fath.

100 and 300 fathoms, and, having been recorded from Danish waters, must at least occasionally move southwards into inconsiderable depths. It occurs, apparently regularly, in the 100-fathom hole off Troup Head in Aberdeenshire (whence presumably wandered the young examples noted from the Yorkshire coast). No record of it exists from the Färö Channel, nor from the deep water west of Scotland, which, however, is practically unexplored.[1]

On the eastern side of the Atlantic its range may be taken to extend from lat. 70° N. off Norway, at least as far south as Cape Verde, chiefly at depths between 100 and 400 fathoms, but as to the influence which temperature and salinity may exercise on its distribution within this zone, available evidence seems to be insufficient. In the *Helga* captures the temperature, when observed, ranged between about 9° and about 11° C., and the observed salinity was usually oceanic, but at S.R. 379 distinctly littoral. Since the species occurs regularly in the North Sea an oceanic salinity cannot be essential to its well-being.

In the Mediterranean it extends as far east as Constantinople, but statements as to its vertical range in that sea lack precision. Since, however, it appears at least not rarely in fish markets, it must to some extent be an inhabitant of moderate depths, though in general affecting those beyond the ordinary range of local fishing operations (cf. Collett, 1896).

On the western side of the Atlantic it seems to be not rare between Lat. 30° and 40° N., at depths of about 71 to 312 fathoms (cf. Goode and Bean, 1896, *H. dactylopterus* and *H. maderensis*).

S. dactyloptera seems to live at the bottom, for we can find no evidence of its capture elsewhere after the larval stages. The thickened, detached, presumably tactile lower rays of the pectoral fin certainly suggest a bottom-groping habit, but it is to be remarked that while their extremities become detached at an early stage, the rays are not thickened until comparatively late in life. In the gurnards which search the ground with their detached rays[2] in a manner familiar to everyone who has seen the fish in an aquarium, these rays are specialised at or before the conclusion of the larval stage (cf. M'Intosh and Masterman, 1897). Since, however, in *Scorpaena cristulata*, in which only the extreme tips of the lower rays are free, these rays, as also those of the ventral fins and the spines of the anal fin, become clothed in adults with thick fleshy integuments, it may be that the thickening has nothing to do with an increase in the sensory mechanism.

It is quite probable that the *Helga's* small slow-moving beam trawl gives no adequate account of the sizes of specimens procurable on the Irish coast by a commercial otter-trawl, and since the "red bream" seems to have established itself in the London market it is likely that the fish landed there run generally larger than those which we have listed. The largest of these is about 16 inches, and the great majority are of less than 12 inches, no

[1] *Note added in Press.*—We have lately received from Dr. R. Norris Wolfenden a specimen taken by the *Silver Belle* in the Färö Channel at 320 fathoms,—temperature 8·7°C.

[2] For description of the sensory apparatus in the pectoral rays of Gurnards cf. Williamson (1894).

great size in the British culinary standard of fishes, to which the alleged Irish comparison of the relative values of the goose and the snipe may be not inaptly compared. Smitt, evidently from autopsy, puts the maximum size of Scandinavian specimens at about 17¾ inches. Holt and Calderwood, on an authority which we cannot now trace, mention a size of 24 inches (*ca.* 573 mm.)

SCORPAENA CRISTULATA, Goode and Bean.

Pl. II.

S. cristulata, Goode and Bean (1895), Jordan and Evermann (1896–98).
S. echinata, Koehler (1896).

S. cristulata and *S. echinata* were described independently from specimens of the same size (150 mm. without the caudal fin) taken respectively off the coast of Georgia, U.S.A., at 440 fath., and in the Bay of Biscay at 722 fath.

Koehler, in a note inserted while his account of the fishes taken by the *Caudan* was in the press, gave it as his opinion that *S. echinata* was certainly identical with *S. cristulata*, and the same view has been adopted by Jordan and Evermann.

Several *Scorpaenae* recently taken by Messrs. Farran and Kemp in deep water off the south-west of Ireland (the smallest of which is longer by about one-third than the two specimens above alluded to) appear to us to be clearly referable to the same species as Koehler's specimen, and we see no good reason for refusing to regard his specimen and the type of *S. cristulata* as specifically identical, the only difference (other than those referable to growth) lying in the number, or supposed number, of the scales, to which, in view of the difficulty we have ourselves experienced in counting the irregularly arranged scales of young *Scorpaenae*, we are not disposed to attach any importance.[1]

With our material and the published descriptions of Goode and Bean and Koehler, the series of specimens described is fairly complete, and the diagnosis which we subjoin will probably ensure the recognition of specimens of any size. In speaking of "young" we refer to examples of

[1] Koehler's drawing seems to represent a more massive fish than that shown by the American authors, with the cephalic armature more fully developed, and his specimen may have advanced further towards the adult form and appearance than the type of *S. cristulata*, although of no greater length.

Koehler remarks on the irregularity of the squamation of his specimen, without giving the actual number of scales; his figure shows about 55 in a longitudinal series from the operculum to the caudal origin; Goode and Bean attribute about 60 in the same distance to their specimen, while their artist has shown a few more than that number, a fact which appears to point to some room for doubt as to the number really present. In the Irish specimens the scales increase somewhat in size posteriorly, Goode and Bean's figure shows them the same size throughout, and Koehler represents the scales of the caudal region as smaller than those opposite the spinous dorsal.

In some other particulars of minor importance the description of the American type is at variance with the figure.

150 mm., as described by the American and French authors; by "adults" we mean specimens of 300 to 504 mm., measured in all cases without the caudal fin. A specimen of 215 mm. may be described as "half-grown"; but this stage seldom requires separate mention in diagnosis, as it is naturally intermediate between the young and adult conditions[1].

Length of head about $2\frac{1}{4}$ in young, about $2\frac{1}{3}$ to $2\frac{2}{7}$ in adults, greatest height of body about 3 to $3\frac{1}{2}$ in total length without caudal fin. Length of snout in young somewhat greater than, in adults about equal to length of orbit. Length of orbit in young about $3\frac{1}{3}$, in adults about $4\frac{1}{4}$, height of caudal peduncle in young about 5, in adults about $3\frac{1}{4}$ to $3\frac{3}{4}$ in length of head. Width between interorbital ridges in young about $2\frac{1}{2}$ to $2\frac{1}{3}$, in adults about 2 in length of orbit.

Lower jaw slightly projecting, mandibular symphysis with a well-marked ventral process in adults. Maxilla reaching to, or nearly to, vertical from hind margin of orbit in adults, relatively shorter in young. Snout with a more or less prominent hump between the olfactory organs. Interorbital space slightly concave, with a pair of feeble carinae internal to the supraorbital ridges. Teeth in bands on the jaws, vomer and palatines, villiform in the young; of moderate size, stout and recurved, interspersed at the front ends of the jaws with villiform in adults. No teeth on the premaxillary symphysis.

Form massive anteriorly; greatest height and width (about $\frac{2}{3}$ of height in adults) at level of anterior spine of dorsal fin. Snout bluntly rounded in dorsal view. Belly somewhat flattened from isthmus to opposite extremities of ventral fins, trunk somewhat compressed post-anally.

Head heavily armed with spines, mostly set in longitudinal series on scaleless ridges. A small inwardly directed spine on either side of snout. Supra-orbital ridges with a single, sometimes bifid, spine at the front end (pre-orbital), followed at an interval by three, of which the first is the smallest, and the third, about opposite hind margin of orbit, usually the largest. Supra-orbital ridges continued on the occiput by slightly diverging ridges armed posteriorly with two keel-like spines, of which the first may be obsolete in adults. Three or more spines in a row behind the eye, forming in adults processes of a more or less continuous ridge, first spine small, second large, keel-like, somewhat deflected in adults, third and fourth at the upper insertion of operculum, the third sometimes bifid, the fourth of uncertain occurrence, present in adults as a low ridge only. Two thin flat spines on the operculum, often obsolete in adults. A strong sub-orbital naked bony ridge extending from above insertion of maxilla to upper posterior angle of preoperculum, set with spines which are arranged in adults in four groups[2]: first group of 1 to

[1] Since our manuscript went to the printers the *Helga* has brought in ten additional specimens ranging in total length from 245 to 520 mm. This new material does not materially affect the diagnosis of characters, and it is only necessary to make note of a colour variety and to complete the list of captures.

[2] In a half-grown specimen the second and third groups are practically continuous and their spines are not deflected.

3 small spines at anterior end of ridge; second of 2 or 3 rather large keel-like, somewhat deflected, below middle or hinder half of eye; third of 3 or 4 similar to last; fourth of 1 large backwardly directed spine, with a subsidiary spine on its anterior shoulder at symphysis of suborbitals with upper angle of preoperculum. Hind edge of preoperculum armed in addition with four serrations, the uppermost small, persistently acute, and (in adults) near the spine of the angle; the remainder wider and more or less completely masked with skin in adults.

Scales relatively rather small, thin, non-deciduous, finely ctenoid at the margin in young, sometimes practically smooth in large adults, wanting in adults on maxilla, and never present on bony ridges of head, praemaxillary and mandibular parts of jaws and underside of head; imperfectly developed on interorbital region; small and not imbricating on ventral region in front of ventral fins; present on basal parts of dorsal and caudal fins; 7 to 9 longitudinal rows above, 15 to 17 rows below lateral line opposite anus; 48 to 53 (60) transverse rows between posterior angle of operculum and origin of central caudal rays.

Dermal processes in the form of short slender filaments, of which one appears to be normally present behind each of the cephalic spines and at each of the pores of the lateral line. Shorter and more slender filaments arise singly or in pairs from more or fewer of the perfectly developed scales of the head and body. A ring of filaments round the eye, those of the dorsal part the stronger and more numerous.[2]

Pectoral fins extending in young considerably beyond level of anus, relatively shorter in adults; their upper rays (except the first) branched; their lower rays unbranched, protruding slightly from the fin-membrane, and covered with a very thick integument in adults.

Ventral fins much shorter than pectorals, and clothed in thick skin in adults.

Dorsal fin commencing in front of posterior angle of operculum, with 11 or 12 spines and 9 or 10 soft rays (XI–XII 9–10); first spine shorter than those which follow it; fourth and fifth spines longest, and last spine much longer than those immediately in front of it.[3] Anterior soft rays longer than spines in adult, equal

[1] *Fide* Goode and Bean.

[2] We are inclined to think that the development of dermal filaments varies a good deal in individuals, since some of our specimens have filaments on the majority of the perfect scales, while others have only a few, as in the case of the specimen figured. None of them show any signs of serious abrasion in the net.

[3] In the young the first spine is very close to second, third nearer to second than to fourth. In large adults the interspaces are nearly equal, that between first and second shorter than that between second and third only by a distance equal to the width of base of second, those between second and third and third and fourth sub-equal. In life the fin membrane may possibly be produced behind the tips of the spines in small lappets, but is more probably simple in outline. Our artist has omitted to note the slight difference in the lengths of the interspaces between the first and second and second and third dorsal spines.

to, or shorter than spines in young; base of whole fin scaly in young,[1] spinous portion practically naked in adults. Soft part obscured basally in adults by thick scale-clad integument extending forward in large examples to base of the penultimate spine.

Anal fin with three spines and five soft rays, second spine longer than third and much longer than first. In adults spines clothed with thick skin, except tips of first and second, skin of second remarkably voluminous.

Caudal fin, when expanded, slightly rounded in young, practically truncate in adults, and slightly emarginate when normally compressed.

General colouration of adults bright red, paler on ventral parts. Blackish or brownish blotches usually present on gill-cover. Indistinct dark mottlings, not forming regular transverse bars, present on body. Pectoral, ventral, and anal fins with more or less black pigment on membrane between rays. All unpaired fins with a rather broad dead-white margin. Spinous part of dorsal fin with black blotches on membrane behind second and few succeeding spines, membrane of posterior rays more or less completely black except at margin. Soft part of dorsal fin, between basal scales and white margin, with black pigment in varying extent—may be almost completely black or only with black streaks between rays. More or less black pigment between rays of caudal fin. Half grown (and probably also young) examples with oblique dark bars on the sides.[2]

Reaches a length of at least 520 mm.

[1] *Fide* Koehler *nec* Goode and Bean.

[2] In an example of 215 mm. (without caudal) the front part of the head is mottled, except ventrally, with brown. The gill-cover behind the preoperculum is almost uniformly blackish brown. The dorsum from the base of the third dorsal spine to the occipital region bears a broad ring of brown. The dorsal fin has a large dark brown patch between the fifth and ninth rays from which an oblique band is continued forward on the side to below the lateral line. The membrane of the soft dorsal rays is blackish and forms the upper part of a second oblique band which reaches the pectoral fin. A third but less distinct band descends from the upper surface of the caudal peduncle, which is in addition rather diffusely mottled. The pectoral has a distinct, broad blackish band on the membrane of its branched rays, and some blackish pigment occurs on the ventral, anal and caudal fins.

In addition to the marks already mentioned the dorsal fin has a large dark spot behind the second, third and fourth spines. All these markings remain quite distinct after a year's preservation in alcohol and formaline. A specimen of 408 mm. obtained in September, 1907, is much darker than any other. The black marking of the dorsal fin in continuous throughout, but is not carried to the base of the last few spines. On the sides from the base of the 6th dorsal spine to well below the lateral line every scale is outlined in dense black. Two completely black patches occur, one below the second half of the spinous part of the dorsal, the other below the soft rays. These patches do not quite reach the lateral line, and have not the appearance of oblique bars noted in the young. The caudal and anal have well marked black patches, but the head and shoulders are not unusually dark.

Measurements, in millimetres, and number of Scales and Fin-rays of Seven Specimens.

a. Type of *S. cristulata.*
b. Type of *S. echinata.*
c. to *g.* Irish specimens, viz. *c*, S.R. 353; *d*, *e*, *g*, S.R. 400; *f.* S.R. 334.

—	*a.*	*b.*	*c.*	*d.*	*e.*	*f.*	*g.*
Total length, ...	175*	172	255	358	419	497	501
Total length without caudal fin.	145* (150)†	150	215	300	352	415	425
Length of head without lower jaw.	60* (68)†	06	89	127	160	178	175
Length of snout, ...	15* (14)†	16	19	30	33	41	38
Length of orbit, ...	20	20	23	30	37	43	38
Width between supra-orbital ridges.	8	7	10	14	18	24	24
Length of pectoral fin, ...	34*	34	46	72	86	97	105
Length of ventral fin, ...	28*	29	36	48	58	60	68
Snout to first dorsal spine, ...	55*	61	74	106	138	159	161
Snout to first anal spine, ...	98*	101	149	210	260	296	296
Anus to first anal spine, ...	—	15	17	25	26	31	30
Height of body at first dorsal spine.	50	46	68	91	120	138	137
Height of caudal peduncle, ...	14	13	23	35	45	48	51
Length of caudal peduncle from base of dorsal fin to anterior caudal ray.	20*	-	29	41	53	63	65
Number of scales above lateral line opposite anus.	8	7	9	9	8	8 or 9	9
Number of scales below lateral line opposite anus.	15	—	16	17	16	17	17
Number of scales between head and caudal fin.	(60 *ca.*)†	—	53	62 *ca.*	48	51	53
Number of dorsal fin-rays, ...	XII 9	XII 9	XII 9	XII 10	XII 9	XI 10	XI 9
Number of anal fin-rays, ...	III 5	III 5	III 5	III 5	III 5	III 5	III 5

Length in millimetres of Spines and Rays of Dorsal Fin.

Spinous Part.	*a.*	*c.*	*d.*	*e.*	*g.*
1st Spine, ...	8	11·5	13	—	28
2nd „ ...	15*	20·5	26	29	40
3rd „ ...	20* (22)†	29·5	36	40	41
4th „ ...	22	30	40	43	43
5th „ ...	22	29	40	41	42
6th „ ...	21	28	36	44	40
7th „ ...	26	27	36	42	38
8th „ ...	17	25	35	39	32
9th „ ...	14	21	31	34	25
10th „ ...	11	18	28	27	22
11th „ ...	10* (11)†	17	24	24	—
Posterior Spine, ...	16* (19)†	28	36	26	38
Longest ray, ...	21* (26)†	32	49	55	63

* Measurements shown in figure.
† These measurements given in the text differ from those shown in figure.

S. cristulata appears to be absolutely confined to deep water, and among deep water teleosteans which have come under our observation, is remarkable for the solidity of its tissues, both bone and muscle being apparently as strongly developed as in the familiar littoral species of the Mediterranean. From *S. dactyloptera*, the common species of our 100 fathom line, it is easily distinguished by the strong sub-orbital ridges and by the lower pectoral rays, which are not produced as apparently tactile organs beyond the fin membrane. In cephalic armature it rather closely resembles some of its congeners relegated by American authors to their genus *Pontinus*, but can be distinguished from them by the branched nature of some of the pectoral rays, all of which are simple in *Pontinus*.[1]

S. cristulata has been trawled off the Irish coast at the following stations:—

S.R. 327.—8-5-'06. 51° 43′ 30″ N., 12° 15′ W. to 51° 38′ N. 12° 18′ W., 550 to 800 fath., ooze. Temperature at 530 fath. 8·95° C., salinity at 500 fath., 35·16 °/$_{oo}$.
One, 445 mm.

S.R. 334.—10-5-'06. 51° 35′ 30″ N., 12° 26′ W., 500 to 520 fath. (Temperature at 51° 37′ N., 12° 9′ W., 500 fath. 9·19° C., salinity 35·10 °/$_{oo}$).
One, 497 mm.

S.R. 353.—6-8-'06. 50° 37′ to 50° 40′ N., 11° 32′ W., 250 to 542 fath., muddy sand. Temperature at 500 fath. 8·85° C.
Two, 255 and *ca.* 450 mm.

S.R. 400.—5-2-'07. 51° 18′ N., 11° 50′ W., 525–600 fath. Temperature at 580 fath. 8·35° C., salinity, 35·50 °/$_{oo}$
Three, 358 to 504 mm.

Other twenty-two specimens were taken in September, 1907, in the same neighbourhood at soundings ranging from 447 to 778 fath. Only two occurred at stations of which the greatest depth was less than 500 fath.

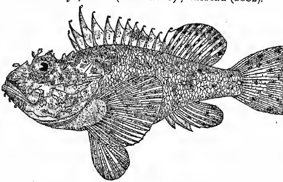
Reference to the list of deep water hauls on p. 17[2] suggests that the species does not occur at less than 400 fathoms off our coast, while it may be practically confined to depths of 500 fathoms or more.

It has also been taken, as already noted, at 722 fathoms in the Bay of Biscay, and at 440 fathoms off Georgia, U.S. America.

[1] This distinction is probably of no value in the case of very young *Scorpaenae* (of about 50 mm. or less) of any species or sub-genus.
[2] The list does not include the hauls made in September, 1907.

SCORPAENA SCROFA, L.

S. scrofa, Lowe (1843–1860); Moreau (1882).



S. scrofa, × $\frac{1}{4}$.—Sketch adapted from Lowe.

Form thick, short, and clumsy; head very heavy and massive, especially in large examples; lower jaw slightly projecting. Head about $2\frac{1}{2}$ or $2\frac{2}{3}$ times in total length (without caudal), depth of body about $2\frac{3}{4}$ to $3\frac{1}{4}$. Length of orbit $3\frac{1}{4}$ to $4\frac{1}{2}$ times in head, diameter of eye considerably less than width of orbit, especially in large examples; length of snout in young about $\frac{4}{5}$ of length of orbit, in large examples equal to or longer than orbit, the relative proportions apparently depending upon the extent to which the circumorbital bones are developed; interorbital width varying in the same way from little more than half of to nearly as great as length of orbit. The long ridges and spines of the head are more developed in large examples, and appear to alter the contour and proportions of the head to a very great extent. Nasal region convex, with a single spine above each anterior nostril; supraorbital ridges standing out far above frontal profile, each with one spine anteriorly and two posteriorly. Interorbital space scaleless and very concave, with two faint ridges internal to the supraorbital ridges, each carrying a single or double spine interior and posterior to last supraorbital spine, and just in front of the broad transverse occipital groove, which they cross as low ridges, subsequently terminating on the nape in two spines, the anterior sometimes double, the posterior large and strong. Below these ridges other ridges run from the orbit backwards, bearing a small double spine near the orbit, and two larger spines near the opercular insertion. One or two more spines are situate on the body above the opercular insertion. Anterior suborbital with four to six strong diverging ribs, some of which overlie the maxilla when the mouth is closed; posterior suborbitals forming a stout ridge somewhat irregularly armed with about three spines. A stout bifid spine at symphysis of suborbitals with preopercular margin, below which, on preopercular margin, are four weaker spines, the lowest of them obsolete in large

specimens. Cheeks and preoperculum scaleless. Operculum dorsally elongated, and armed with two strong ridges, each carrying a stout adpressed spine. D. XII 9–10; A. III 5; the third spine largest. Rays of lower half of pectorals unbranched, and covered with thick skin in large examples. Caudal truncate. Scales about 40–45 in a longitudinal and 22–24 in a transverse series, somewhat irregular in arrangement. Head, mandible, and body with numerous lappets of skin, which may be very feebly developed in small examples.

Colours very variable, ordinarily some shade of vermilion, varying from orange to a deep ruddy cherry colour; head and cheeks with dusky and deep-red marblings and spots; body and fins with smaller speckles of various colours. A large dusky spot on posterior part of spinous dorsal.

The proportions and degree of development of the cephalic ridges in this fish are subject to very great variation. Lowe, who was well acquainted with the species, says—"Two states or varieties, depending chiefly upon age or size, may be distinguished of this fish; but they run so much into each other in respect to sex, locality, and season, as well as characters, that it had scarcely been desirable separately to define them, might not the observation of isolated individuals lead possibly to their erroneous distinction into species. That which may be called the normal sort, since it comprehends the largest full-sized fishes, from 15 to 20 inches long (Lowe's var. *obesa*), is deeper in proportion to its length than the other variety (Lowe's var. *histrio*), with the belly somewhat prominent or corpulent. The head, in consequence, seems shorter; and the eyes, though varying in this respect, are generally somewhat larger. The colours are altogether lighter or paler. . . . Such fishes are in general, but not uniformly, females; and full-sized old or aged fishes, of 18 or 20 inches long, almost invariably present these characters. They are said to be caught in deeper water, and further from the shore than the other sort."

"The other sort is a more slender or shallow fish; with the ventral line straight from the throat to the anal fin. The eye again varies in size, but is generally smaller. The head appears much thicker and longer, in consequence of its length greatly exceeding the depth; but is not actually longer or thicker in proportion to the whole length of the fish. The colours are altogether darker. . . Such fish are caught nearer the shore or in shallower water than the others. . . . I have seen them of both sexes and at all seasons; but of never more than fifteen inches in length, and they are generally male fishes."

We have seen some specimens from depths of over 100 fathoms near Gibraltar which seemed to show some of the characters of Lowe's var. *obesa*, and also specimens from similar localities which, at about the same size, did not. The few other specimens of the species which we have carefully examined certainly showed a very wide range of variation, but we do not know from what depths they came, although none of them appeared to have either the pale colours or deep bodies of the var. *obesa*. Lowe does not mention the depth at which his specimens of that variety were

taken, but states in his note on *Sebastes Kuhli* that that species "is said to live in deeper water than the Carneiro (*S. scrofa*, L.), being caught with lines of from 100 to 250 fathoms, *i.e.* in a depth of from 3 or 4 to 10 linhas, instead of from 50 to 100 fathoms," so, presumably, the range of *S. scrofa* at Madeira, as in the Mediterranean and off Gibraltar, is not known to extend far below the 100 fathom line. As a littoral species it is unknown in British-and-Irish waters, but, like other species occurring both inshore and as deep as 100 fathoms at Madeira or in the Mediterranean, such as *Spinax niger* and *Pristiurus melanostomus*, it may occur in our area as a deep-water species only.

iii.—Fam. *ALEPOCEPHALIDAE*, Boulenger (1904).

These are exclusively deep-sea fishes, occurring in the Atlantic (including the Mediterranean) and Pacific Oceans, but apparently absent from the polar regions of either. In general external characters they may be said to be more or less compressed in form, sometimes considerably elongate. The head is scaleless, the body scaled or scaleless, sometimes set with numerous small tubercles having the structure but little of the appearance of luminous organs. The eyes are usually large, the mouth large or at least of moderate size, the margin of the upper jaw formed by the premaxillae and maxillae, the teeth small. The fins have no stout spinous rays; the dorsal is set far back opposite the hind part of the anal, which is at least as long as the dorsal and often much longer. Both fins are low, and there is no adipose fin. The pectoral and ventral fins are not large, the latter sometimes wanting, and, when present, usually set far back. The colour is generally black or dark brown.

Genus *ALEPOCEPHALUS*, Risso.

As we understand the limits of this genus it may be defined as follows:—

Form moderately elongate and compressed; height of body less than length of head (including the membranous part of gill-cover). Length of head in adults not more than one-third of total length (without caudal fin). Cleft of mouth of moderate width, with the jaws nearly even in front; maxillae toothless, never extending beyond level of hind edge of orbit; small teeth on premaxillae, mandibles and palatines, absent from vomer, or if present, minute. Snout of variable length. Eye large. Opercular openings wide, gill membranes entirely separate. Opercular bones large and thin, their posterior edges imperfectly ossified; branchiostegals 6 (perhaps 7 in some species).

Pectoral and ventral fins well developed but relatively small. Dorsal and anal fins placed far back and opposite to one another; anal as long as or longer than dorsal. Caudal forked.

Head scaleless and covered with rather tough skin. Body covered with scales, thin, cycloid, and more or less deciduous, sometimes masking bases of dorsal and anal fins.

Deep-sea fishes of wide range in temperate and tropical seas, apparently absent from arctic and antarctic waters.

Goode and Bean (1895) have given a key to the species which they refer to *Alepocephalus*, and have placed other closely allied forms in a new genus, *Conocara*. The distinctions upon which they rely for the separation of the latter are in part contradicted by their own specific definitions, and appear to us insufficient to justify the generic separation from *Alepocephalus* of the forms placed in it. While defining *Conocara* as having no teeth on the palatines, they describe palatine teeth in both *C. Macdonaldi* and *C. macroptera*, and, presumably as the result of a clerical error, they also ascribe maxilliary teeth to the latter. *Alepocephalus* is credited with "small," *Conocara* with "acicular" teeth, but to us the teeth of the two suggested genera do not appear to differ materially in character. *Conocara* has the "mouth moderate, snout prolonged." So also have *A. niger* and *A. Blanfordi*. *Conocara* is said to have the anal fin "very elongate, nearly twice as long as the dorsal." It is in fact more than twice as long in *C. macroptera*, but in *A. niger*, *A. bicolor*, and *A. edentulus*, it is also very elongate and considerably longer than the dorsal. The scales are described in *Conocara* as "minute and deciduous." They are minute, but the difference in size which separates them from those of *A. niger* is only one of degree, and is not greater than the difference between those of the latter species and *A. rostratus*. The statement that in *Conocara* the branchiostegal membrane of the left side is folded conspicuously over that of the right, is equally applicable to at least one species of *Alepocephalus* (*A. rostratus*). The only external distinctions which seem to be valid are that in forms referred to *Conocara* (1) the maxilla does not extend beyond the vertical from the front margin of the eye; (2) the anal fin is about twice as long as the dorsal; (3) about 200 rows of scales cross the lateral line; whereas in all other known species of *Alepocephalus* the maxilla is relatively more or less longer (very little in *A. niger*), the dorsal fin is considerably more than half as long as, and sometimes equal in length to the anal, and the number of rows of scales which cross the lateral line is never greater than about 150, and may be as low as 50. It is not likely that the list of *Alepocephali* is complete, and since existing forms show a good deal of diversity in combination of characters, there seems to be no good reason for retaining *Conocara* as a genus. As a sub-genus it has its merits, which is more than can be said for *Mitchillina*, proposed as a genus by Jordan and Evermann, and very imperfectly defined or definable.

In the following key we show what appear to us to be the more salient characters that may be employed in distinguishing the species referred by us to *Alepocephalus* from one another. We have, however, refrained from attempting to do more than group the described species in such a manner as to facilitate the

preliminary determination of any example, as most of these forms are known to us from figures and descriptione alone; and we wish to refrain from expressing any view as to the validity or otherwise of species founded upon specimens which we have not examined.

The key must of course be used in the light of a general knowledge of the developmental changes of form in deep-sea fishes, since in some cases we have no means of knowing whether existing descriptions are founded upon specimens which have attained adult characters.

We cannot regard the lengths of the head and eye in this genus as altogether satisfactory characters for the purposes of a key. The bony part of the gill-cover seems to be too variably ossified to afford a constant hinder boundary for the head, and the membranous part may be defective, while the length of the eye may be based in description and figure indifferently on the whole organ or on so much of it as is not concealed by the integuments. In using the length of orbit in relation to that of the snout for broad distinctions, we believe we are justified by the adequacy of either description or figure of the species concerned. Although the scales of *Alepocephali* are more or less deciduous and the skin is soft, there is in fact no great difficulty in reading the scale formula within the wide limits here adopted.[1]

I. Dorsal and anal fins of the same or almost the same length.

A. Scales large, about 50 to 70 series crossing the lateral line.

(i.) Horizontal diameter or orbit about equal to or greater than length of snout. Maxilla reaching to about level of centre of eye.

(*a.*) Length of base of anal fin much greater than combined lengths of snout and orbit. D. 18-22. A. 20-25.

(1.) *A. rostratus*, Risso (1820).
Mediterranean and neighbouring parts of Atlantic, 400 (?) to 1,997 fath.[2]

(2.) *A. Bairdi*, Goode and Bean (1879 and 1895), Günther (1887), Jordan and Evermann (1896-98).
North-Western Atlantic, 200 fath.

(3.) *A. Giardi*, Koehler (1896).
North-Eastern Atlantic, 350 to 776 fath.

[1] Goode and Bean's key of *Alepocephalus* is not intelligible, on account of the use made in it of the characters of the opercular flaps. The species are equally divided into those in which the opercular flaps are said to be "voluminous," and those in which they are "moderate." Among the latter is placed *A. edentulus*, among the former *A. Blanfordi*, but so far as we can interpret such a character at all the *Investigator* figures seem to show the flaps more voluminous in *A. edentulus* than in *A. Blanfordi* or any other species.

[2] No data of depth of occurrence in Mediterranean are available.

(b.) Length of base of anal about equal to combined lengths of snout and orbit. D. 16-17. A. 17-19.

(4.) *A. asperifrons*, Garman (1899).
Pacific Coast of Central America, 780-1,020 fath.

(ii.) Horizontal diameter of orbit less than length of snout. Maxilla only reaching to below front of eye. Base of anal shorter than combined lengths of snout and orbit. D 16-17. A. 17.

(5.) *A. Blanfordi*, Alcock (1892 and 1899), Illust. Zool. Invest. (1894.)
Arabian Sea, 902 fath.

(6.) *A. productus*, Gill (1883), Günther (1887), Goode and Bean (1895), Jordan and Evermann (1896–98).
North-Western Atlantic, 1,360 fath.

B. Scales of moderate size, about 85 to 100 series crossing the lateral line. D. 15–18. A. 17–19.

(7.) *A. Agassizi*, Goode and Bean (1882 and 1895), Günther (1887), Jordan and Evermann (1896–98). Lütken (1898).
North-Western Atlantic, 922 fath. South-West of Iceland, 912 fath.

(8.) *A. tenebrosus*, Gilbert (1891), Jordan and Evermann (1896–98).
Pacific Coast of North America, 360–820 fath.

(9.) *A. fundulus*, Garman (1899).
Pacific Coast of Central America, 1,270–1,670 fath.

(10.) *A. convexifrons*, Garman (1899).
Pacific Coast of North America, 660 fath.

II. Anal fin considerably longer than, but not more than half as long again, as dorsal. D. 20–30. A. 26–35.

A. Scales large, 50 to 70 series crossing lateral line.

(11.) *A. edentulus*, Alcock (1892 and 1899), Illust. Zool. Invest. (1900).
Bay of Bengal, 475 fath.

(12.) *A. bicolor*, Alcock (1892 and 1899), Illust. Zool. Invest. (1892), Brauer (1906).
Indian Ocean, 240–410 fath.

B. Scales small, about 140 series crossing lateral line.

(13.) *A. niger*, Günther (1878 and 1887).
South-Western Pacific, 1,400 fath.

III. Anal fin nearly twice as long as dorsal. D. 18–21. A. 36-40. Scales very small, about 200 series crossing lateral line. (*Conocara*).

(14.) *A. macropterus*, Vaillant (1888).
Northern Atlantic, (68) 235 to 1,156 fath.

(15.) *A. Macdonaldi* (Goode and Bean, 1895), Jordan and Evermann (1896–98).
Gulf of Mexico, 955 fath.

For the purposes of these notes we are only concerned with species which fall into the divisions I A (i) (*a*) and III, since the other divisions are not so far represented in collections made on the European Atlantic slope.

Messrs. Farran and Kemp have tested the gastronomic properties of *A. rostratus* and *A. Giardi*, and pronounce them to be indifferent. The flavour is distinct and unpleasant, while the texture is disagreeably gelatinous.

We cannot account for the exceedingly bad condition of Vaillant's material of the genus. He speaks of specimens coming to pieces in the process of examination. Our specimens, which were naturally derived from similar depths, must have come on board in excellent condition, and though the scales mostly fell off *A. rostratus* and *A. Giardi* and more or less of the fin-membrane is missing, the general tissues are in excellent condition after preservation in 5 per cent. formaline, and quite firm, though not stiff like those of more solidly built fishes. It is true that some *A. rostratus* placed at the bottom of trays in the *Helga's* store tank are very much flattened and of no use for study of the natural height of the body, but our material is sufficiently abundant to admit of neglect of these specimens. Some of the specimens of *A. macroptera* are practically perfect even as to scales. The experience of one of us suggests that Vaillant's specimens, though no doubt properly preserved in alcohol of the right strength when captured, may have subsequently been exposed for a lengthened period to a somewhat high temperature (probably unavoidable in the region of research covered by the *Travailleur* and *Talisman*), and may in this way have undergone a certain amount of maceration before they reached the museum. Fortunately or otherwise, collections made off the coasts of this island are not liable to danger from an unduly high temperature, other than that which may be traceable to proximity to the engine room.

ALEPOCEPHALUS ROSTRATUS, Risso (1820).

Pl. III, Fig. 1.

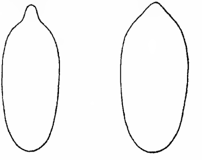
Alepocephalus rostratus, Cuvier and Valenciennes (1828-49), Johnson (1862), Günther (1887), Moreau (1882), Vaillant (1888), Goode and Bean (1895).

Form (in specimens of 220 mm. and upwards, without the caudal fin) somewhat elevated, compressed, greatest height of body (between vent and ventral fins) about 4 to 5 in total length (without caudal); *back with a distinct narrow ridge running forward from dorsal fin to near region of shoulder.* Length of head, with gill-cover membranes, about $3\frac{4}{5}$ to $3\frac{1}{4}$ in total length without caudal fin; hind margins of gill-covers nearly horizontal. Horizontal diameter of orbit about equal to or a little greater than length of snout, about 4 in length of head. Eye without external occluding membrane. Width between supraorbital ridges opposite middle of eye a little more than $\frac{2}{3}$ of horizontal diameter

of orbit in adults, relatively less in young. Inter-orbital space nearly flat. Snout more or less prominently arched in profile over nasal region and inflected in front of it; a rather conspicuous depression at nape. Jaws subequal or with the lower slightly projecting. Maxilla reaching about to vertical from centre of pupil but somewhat variable, its posterior edge obliquely truncate, with broadly rounded posterior angle. Mandible reaching almost or quite to vertical from hind edge of orbit. Teeth small, sharp, closely set, in single series on premaxillae, mandibles, and palatines. Vent at more than $\frac{2}{3}$ (·67 to ·70) of total length without caudal. Pectoral fins a third to nearly a half longer than orbit, their bases at some distance from gill-cover membranes. Ventral fins longer than orbit, set a little behind middle point of total length without caudal fin, not reaching vent. Dorsal and anal fins of nearly equal length, their bases fleshy and clothed with scaly integument which more or less masks the small anterior rays. Dorsal, commencing about opposite to vent, with about 16 to 20 rays; anal, continued some way behind dorsal, with about 18 to 22 rays. Caudal fin forked, its dorsal and ventral rays extending some way forward above and below peduncle. Caudal peduncle of variable height, about $\frac{1}{3}$ more or less of length of head; its length, measured from vertical of end of base of dorsal to origin of central caudal rays, more than $\frac{1}{3}$ but considerably less than $\frac{2}{3}$ of length of head.

Scales large, much longer than broad, truncated in front and rounded at their free edges, but tending to become pointed on the back and belly and at the base of the dorsal and anal fins, pearl-coloured with violet black exposed margin, in about 51 to 54 transverse rows between head and central caudal rays, and about 8 or 9 longitudinal rows above and about 10 to 14 below lateral line; present on all parts of body (except behind base of pectoral fin), and on bases of median fins. Colouration practically uniform black in life, head deep velvety black, body purplish black (except where scales are exposed by fraying off of the natural dark epidermal covering). Size, reaches 590 mm., including caudal fin.

For measurements of specimens, see p. 44.



1 2

Section in front of dorsal fin.

1. *A. rostratus.* 2. *A. Giardi.*

The form of the back of *A. rostratus* is more easily expressed by diagram than in text, and we therefore refer readers to the figures given above, in which sections of *A. rostratus* and *A. Giardi*, taken some way in front of the dorsal fins, are shown side by side. It will be seen that in *rostratus* the sides, converging towards the middle line of the back, are abruptly elevated into a distinct ridge, whereas in *Giardi* they meet in the manner usual in fishes of moderately compressed form, and are without any marked interruption of the general direction of convergence. In the last-named species the back becomes somewhat flattened in the anterior region, but in *rostratus* the ridge is commonly more or less well defined as far forward as the shoulders. It is in fact a forward continuation of the thick fleshy base of the dorsal fin, and may be supposed to be homologous with the remarkable dorsal ampullation of the presumably larval form which Vaillant described under the name of *Anomalopterus pinguis*, and with the bladder-like expansion of the embryonic dorsal fin which characterises the larvae of some species of *Scopelus* (Holt, 1898).

The scales of *A. rostratus* are deciduous, but a good proportion of them are found *in situ* in specimens which have not been much injured in the trawl, and permit of reasonably faithful restoration by the artist. They extend, however, somewhat further on to the rays of the dorsal and anal fins (and are there narrower and more pointed) than is shown in our figure. The fin-rays, though slender, are tough, but the fin-membranes are very delicate and are practically wanting in all our material. The tissues of the body are very soft when fresh, and specimens subjected on first preservation to the pressure of superincumbent material, become flattened to almost pleuronectid form. Such have naturally been neglected in our record of measurements and proportions. Females of 440 mm. without the caudal fin are mature, and it is probable that maturity is reached at a smaller size, though of this we have no evidence. The nearly ripe ovarian ova are large, probably at least 2·5 mm. in diameter, but none were measured. Females with such ova were taken in May and August, 1906.

The stomach of one specimen contained a hermit crab, *Eupagurus excavatus*, or the like. Several others examined contained no recognisable food.

Specimens were taken in the *Helga's* trawl at the following stations :—[1]

S.R. 327.—8-5-'06. 60 mi. W. ¾ N. of the Tearaght Light. 51° 46′ N., 12° 14′ 30″ W., 550 fathoms, ooze. Temperature at 530 fathoms, 8.95°C., salinity at 500 fathoms, 35·16 ‰

Six specimens, 365 to 563 mm.[1]

[1] The measurements given in this list were made on capture and purport to be accurate only to the nearest centimetre, except in the case of S. R. 327, when the fish were measured after preservation to the nearest millimetre. The smallest specimen from this station had lost its caudal fin.

S.R. 331.—9-5-'06. 51° 12′ N., 11° 55′ W. 610 to 680 fathoms, ooze.

Three specimens, 510 to 550 mm.

S.R. 353.—6-8-'06. 50° 37′ to 50° 40′ N., 11° 32′ W., 250 to 542 fathoms, muddy sand. Temperature at 500 fathoms, 8·85°C.

Three specimens, 510 to 590 mm.

S.R. 359.—7 and 8-8-'06. 60 mi. W. by N. of Tearaght Light, 51° 59′ N., 12° 9′ W., 492 fathoms, ooze. Temperature at 475 fathoms, 9·04°C.

One specimen, 560 mm.

S.R. 387.—7-11-'06. 51° 47′ N., 12° 12′ W., 530 to 535 fathoms, ooze. Temperature at 500 fathoms, 9.13°C., salinity 35·39°/$_{oo}$.

One specimen, 280 mm.

S.R. 397,—2-2-'07. 51° 48′ to 51° 44′ N., 12° 6′ 30″ to 12° 4′ W., 646 to 549 fathoms, ooze. Temperature at 500 fathoms, 8·71°C., salinity 35·55°/$_{oo}$.

One specimen, 480 mm.

S.R. 400.—5-2-'07. 51° 22′ 30″ to 51° 16′ N., 11° 48′ to 11° 50′ W., 525 to 600 fathoms, grey ooze. Temperature at 580 fathoms, a few miles to south-west, 8·35°C., salinity 35·50°/$_{oo}$.

Nine specimens, 280 to 520 mm.

A. rostratus has long been known from the deep water of the Mediterranean, but we have seen no precise statement of its vertical range in that sea nor of the size to which it there attains. Vaillant records 24 specimens from the Azores, Cape Verde, Canaries, coasts of the Soudan and Morocco and the Banc d'Arguin (20° N.) at depths ranging from 454 to 1,997 fathoms. His collection, however, admittedly comprises some which could not be determined with absolute certainty, and at least one which seems to have been *A. Giardi*.

Richard (1904) records a single specimen of *A. rostratus* from 986 fathoms in the Bay of Biscay, but none were taken there by the *Caudan*. Our own records extend the range northwards to the deep water off the south-west coast of Ireland, where the 400 fathom line may be supposed to be somewhere near the upper limit of vertical distribution. In one haul in which specimens were taken the least soundings were 250 fathoms, but the haul also included soundings down to 542 fathoms, while those in all other hauls were at least 492 fathoms. The greatest depth of capture was 778 fathoms. Deeper grounds in this region are as yet practically unexplored,[1] but from the 400 fathom line shorewards the *Helga* has made many hauls, without revealing the presence of the species. A certain amount of trawling has been done off the Mayo section of the coast, at depths extending to about 500 fathoms, without encountering *A. rostratus*, which is likewise absent from the list of fishes taken by the *Michael Sars* off the Färös and Hebrides in similar soundings.

[1] For analysis of hauls see p. 17: for additional records see p. 36.

ALEPOCEPHALUS GIARDI, Koehler (1896).

Pl. III, Fig. 2; Pl. IV, Figs. 1, 2.

A. Giardi, Collett (1905).

Form elongated and compressed, greatest height of body between vent and ventral fins, and about $5\frac{1}{2}$ to 6 in total length without caudal fin; back rather flattened anteriorly and without any trace of a ridge in front of dorsal fin. Length of head, with opercular membranes, about 3 to 4 in total length without caudal fin (3 times or a little less in specimens of 250 mm. or under, 4 times or rather less in specimens of 500 mm. or over). Opercular membranes with an obliquely descending margin and longest ventrally. Horizontal diameter of orbit greater than length of snout, and about 3 to 5 in head (3 times or a little more in specimens of 200 mm. or under, $4\frac{1}{2}$ times or more in specimens of 550 mm. or over). Eye as in *A. rostratus*. Width between supraorbital ridges opposite middle of eye more than $\frac{2}{3}$ of horizontal diameter of orbit (in specimens exceeding 350 mm.) not more than $\frac{1}{2}$ such diameter in very young; interorbital space depressed internal to supraorbital ridges, but reaching their level in central region. Snout only slightly arched in profile over nasal region and scarcely inflected in front of it, but rather variable in both particulars; profile descending more steeply from level of eye in large than in small examples. Depression at nape inconspicuous or absent. Jaws subequal or with the upper slightly projecting. Maxilla reaching about to vertical from centre of eye or even to hind margin of orbit in adults, relatively shorter in young, its posterior edge very obliquely truncate with narrowly rounded posterior angle. Mandible reaching beyond hind margin of orbits in adults, relatively somewhat shorter in young. Teeth as in *A. rostratus*. Vent at about $\frac{2}{3}$ of total length without caudal. Pectoral fins a third or more longer than orbit, their bases close to margins of gill-cover membranes. Ventral fins apparently relatively shorter than in *A. rostratus* (imperfect in our material), set at or a little in front of middle point of total length without caudal fin, not reaching vent. Dorsal and anal fins of nearly equal length, their bases of moderate size, not very fleshy, clothed with scales. Dorsal, commencing opposite or a little behind vent, with about (18 ?) 20 to 23 rays. Anal, continued some way behind dorsal, with about

[1] *A. rostratus*—additional records may be epitomised as follows:—

S.R. 477, 28-8-'07, 707-710 fath. One, 55 cm.
S.R. 483, 30-8-'07, 610-664 fath. One, 46 cm.
S.R. 487, 3-9-'07, 540-660 fath. One, 50 cm.
S.R. 489, 4-9-'07, 720 fath. One, 52 cm.
S.R. 490, 7-9-'07, 470-491 fath One, 38 cm.
S.R. 491, 7-9-'07, 491-520 fath. Five, 37 to 55 cm.
S.R. 493, 8-9-'07, 533-570 fath. One, 54 cm.
S.R. 494, 8-9-'07 550-570 fath. One, 52 cm.
S.R. 499, 11-9-'07, 666-778 fath. One, 40 cm.
S.R. 506, 12-9-'07, 661-672 fath. One, 51 cm.

21 to 25 rays. Caudal fin as in *A. rostratus.* Height of caudal peduncle about ⅓ of length of head in adults, relatively less in young; its length, measured from vertical of end of base of dorsal to origin of central caudal rays, about ¾ of length of head in adults. Scales longer than broad, the free margins more or less angular in form, not simply rounded as in *A. rostratus*,[1] though scarcely angular on anterior parts of sides; brownish grey in colour with black margin, and in about 60 to 67 transverse rows between head and origin of central caudal rays, and about 6 to 8 longitudinal rows above and about 9 or 10 below lateral line, present on all parts of body (except as in *A. rostratus*) and on bases of median fins. Colouration as in *A. rostratus*. Size, reaches 840 mm. including caudal fin.

A male *A. Giardi* of 378 mm. without caudal fin appears to be immature. Another of 522 mm. has the testes still small, but is probably mature. A female of 730 mm. has the ovary full of spawn, the largest ova measuring about 3·5 mm. in diameter. These were semi-translucent when the specimen was first examined after some months' preservation in formaline, and are probably nearly ripe, but smaller than they would have become after extrusion and swelling in the water. No oil-globules were noticed on casual examination, and as the specimen was afterwards transferred to alcohol their presence or absence cannot now be determined. The date of capture was 9th May, 1906.

No food was found in the stomachs of several specimens examined.

For measurements of large specimens see page 44.

The smallest specimens that can be referred to *Alepocephalus* are 9-11 mm. in length (without caudal fin), and lack their integuments and the greater part of their fins in addition to having suffered from more or less crushing. They appear to differ from larvae of similar size attributed by us to *Bathytroctes* in the absence of the supra-clavicular appendage present in the last named specimens and in the toothless maxilla, while in such remains of fins as are left, and in the form of the head, they resemble them. The presence in the net in which they were captured of undoubted *Alepocephalus* larvae of larger size affords some further ground for referring them to that genus.

Of the generic identity of the specimens hereafter mentioned we do not think there can be any doubt, and those of 35 mm. and upwards seem to be undoubtedly referable to *A. Giardi* ; the smaller specimen figured by us we also regard as belonging to that species, and others of the same approximate size do not appear to differ from it in any material respect, although the risk involved in relying upon the number of fin-rays as a character for distinguishing *A. Giardi* from *A. rostratus*, and the somewhat crushed condition of the specimens, makes it unsafe to attempt to refer them with absolute certainty to the former.

The general appearance of a specimen 20·5 mm. long (without the caudal fin) is shown in Pl. IV, fig. 1. It is difficult to ascertain

[1] The scales are not correctly shown in our figure. They should be slightly more angular in outline.

the true contour of the opercular and abdominal regions, and it is possible that our figure represents them as proportionately rather too deep; a larval fin-fold may at this size persist between the anal and caudal fins, as well as between the dorsal and caudal. Save in these particulars our figure shows accurately enough the appearance of specimens of between 19 and 23 mm. long (without the caudal fin); we refrain from setting out the measurements of these small, and often crushed or damaged specimens, but in all of them the length of the head is contained about 3 times, and the length to the origins of the dorsal and anal fins $1\frac{1}{3}$ times or a little more in the total length without caudal; the eye is longer than the snout, and its longitudinal diameter is contained 3 times or slightly more in the head, and the maxilla reaches as far as the level of the centre of the eye, or a little short of it; the head is at least $1\frac{1}{2}$ times as deep as the body at the origin of the ventrals, and nearly $2\frac{1}{2}$ times as deep as the caudal peduncle. There are about five small teeth on each side on the mandible and premaxilla, the maxilla is toothless.

The outline of the pectoral girdle is plainly visible through the skin; there is no supra-clavicular appendage (such as is well marked in *Bathytroctes* at the same size). The pectoral fins are small, the ventrals well developed and situate somewhat nearer to the caudal origin than to the point of the snout. The dorsal and anal fins originate opposite to one another; their rays appear to be, D. 20–23, A. 21–25.

Myomeres cannot be counted, but are apparently more numerous than in *Bathytroctes*, and no sign of developing scales can be detected.

Lower part of head, operculum and abdominal region very darkly pigmented, the rest of the body after preservation pale fawn or sepia.

The next stage represented is of the length (without caudal) of 35–36 mm. (see Pl. IV, fig. 2). The differences between this stage and the last are such as might be expected to occur with growth; the eye is relatively smaller, the fins more developed, and we can see no trace of the larval marginal fin. The teeth in the upper jaw appear to be relatively smaller, and are confined to the premaxilla. Myomeres cannot be counted, but there seem to be signs of developing scales on the anterior part of the body. Colours much as in the smaller specimens, but generally darker, the caudal region and upper parts being sepia rather than fawn.

A specimen 47 mm. long (without caudal) is rather damaged; the changes in proportions with growth continue, and the points worthy of note seem to be the comparatively more anterior position of the ventrals, the apparent further reduction in comparative size of the teeth, the generally darker colour, and the practical certainty that there have been scales on the anterior part of the body.

A specimen 72 mm. long (without caudal) is again more darkly pigmented, and has had a complete scaly covering to the body, L.l. about 66. Relatively to the eye the maxilla appears longer than in earlier stages, and carries a few very minute teeth. The

ventrals originate a little posterior to midway between the point of the snout and the caudal origin, but apparently comparatively farther back than in the specimen of 47 mm. The bones of the pectoral girdle are barely visible through the skin.

Our records of *Alepocephalus* furnish no explanation of the apparent immunity from capture of the larvae of *A. rostratus*, which seems to be commoner in the region investigated than *A. Giardi*.

In regard to specimens of adult form it is easy to distinguish *A. Giardi* from *A. rostratus* by the absence of the dorsal ridge[1] and consequent less height of the body, by the longer caudal peduncle and by the greater number of scales. Vaillant, who doubtfully counted the traces of 71 scales in a specimen which he supposed to be *A. rostratus*, may probably have had to do with *A. Giardi*, since he remarks that his specimens of *Alepocephalus* were in such bad condition that specific differences may have been overlooked. The scales of *A. Giardi* are more deciduous than in *A. rostratus*, and the fin-rays considerably more brittle, but the tissues of the body are firmer and the form is not subject to serious alteration by pressure under the ordinary circumstances of preservation.

A. Giardi comes at least very near to *A. Bairdi*, an older species known from a single specimen, measuring about 620 mm. without the caudal fin, taken at 200 fathoms on the Newfoundland Banks. It may be briefly described, abridging Goode and Bean's text, as follows:—D. 22, A. 25. Scales 7/65/11, free part of scales triangular in form. Length of head $4\frac{3}{5}$, height of body $5\frac{1}{3}$, height of caudal peduncle 11 in total length without caudal fin. Snout as long as orbit, about $4\frac{1}{4}$ in length of head. The figure shows the snout abrupt, rather inflated above the nostrils, and shorter than the orbit, and the lower jaw is shown as projecting beyond the upper. The pectoral fin is shown somewhat remote from the gill-cover membrane.

There is nothing in the formulae of scales and fin-rays to distinguish *A. Bairdi* from *A. Giardi*, and as the type of the former was captured by a fishing schooner its proportions may well have been somewhat altered by post-mortem changes before it reached the hands of a naturalist.

Our nearest example of *A. Giardi* in point of size measures 560 mm. without the caudal fin, and has length of head about $3\frac{3}{4}$, height of body less than $5\frac{3}{4}$, height of caudal peduncle about $12\frac{1}{3}$ in total length without caudal fin, orbit a little longer than snout, and about $4\frac{1}{2}$ in length of head.

Our table of measurements (p. 44) demonstrates the existence of considerable minor variations of proportions in *Alepocephali* even when preserved in formaline on capture, and we have noticed that undue drying tends to emphasise the prominence of the snout above the nostrils even after fixation in formaline, while the same process would undoubtedly shorten up the gill-cover membranes, which the figure shows to have been used, as in our measurements, as defining the length of the head. By

[1] See text-figure on p. 33.

altering the snout of *A. Bairdi* to its probably normal form and extending the possibly shrunken or defective gill membranes to the neighbourhood of the base of the pectoral, any serious discrepancy of proportion between that form and *A. Giardi* would be removed. The form of the scales demands remark. In *A. Bairdi* they are described as having the free part triangular, and are so depicted all over the body, mostly, one may suppose, in restoration. Koehler's type of *A. Giardi* had no scales. Taking Collett's figure with his description it appears that he found them somewhat produced, but hardly triangular. In our specimens the scales are exceedingly deciduous, but at least one specimen retained a considerable number when it first reached the hands of one of us, who failed to notice any conspicuous difference in the shape of the scales as between *A. Giardi* and *A. rostratus*, though difference in colour was obvious.

All our specimens are now scaleless, except in the pectoral region where the scales are more or less rounded, certainly not triangular in posterior outline. It is not improbable from the appearance of the scale insertions that the scales of the sides in *A. Giardi* are more pointed than in *A. rostratus*, but we believe them to be less so than in the figure of *A. Bairdi*, and we suspect that the appearance of that figure may be due to a general restoration of scales on the evidence of the lateral line or fin bases.

While it is possible that *A. Bairdi* and *A. Giardi* are identical, no serious inconvenience is likely to arise from the retention of Koehler's name for European specimens until opportunity may arise of comparing them with the American type. Koehler, in describing *A. Giardi*, notes the proportions of *A. Bairdi*, but does not seem to have considered the difference in size between his type and that of the American species. Collett notes the resemblance between the two species in scales and fin rays, remarking that *A. Giardi* has a bigger head, and differently placed anus and dorsal, but this last difference does not seem to be supported by measurements.

Adult or half-grown specimens of *A. Giardi* were taken in the *Helga's* trawl at the following stations[1] :—

S.R. 327.—8-5-'06. 60 mi. W. ¾ N. of the Tearaght Light. 51° 46′ N., 12° 14′ 30″ W., 550 fathoms, ooze. Temperature at 530 fathoms, 8·95°C., salinity at 500 fathoms, 35·16 °/$_{oo}$.

One specimen, 530 mm. (without caudal fin).

S.R. 331.—9-5-'06. 51° 12′ N., 11°55′ W., 610 to 680 fathoms, ooze.

Three specimens, 530 to 850 mm.

[1] More recent captures may be epitomised as follows:—

S.R. 400.—5-2-'07. 525-600 fath. Three, 43-68 cm.
S.R. 484.—30-8-'07. 602-610 fath. One, 69 cm.
S.R. 489.—4-9-'07. 720 fath. One, 74 cm.
S.R. 495.—8-9-'07. 346-400 fath. One, 63 cm.
S.R. 505.—12-9-'07. 464-627 fath. One, 61 cm.

S.R. 365.—10 and 11-8-'06. 51° 25′ N., 11° 32′ W., 385 to 440 fathoms, sand and stones. Temperature at 380 fathoms, 9·44°C.

One specimen, 652 mm.

S.R. 440.—16-5-'07. 51° 45′ N., 11° 49′ W., 389 fathoms. Temperature at 300 fathoms, 9·94°C.

One specimen, 550 mm.

The larvae and young above recorded occurred as follows:—

Helga CXX.—24-8-'01, 77 mi. W.N.W. of Achill Head. Townets on trawl, 382 fathoms.

One specimen, 20·5 mm. (without caudal fin).

S.R. 327 (see above).—Sprat net and townets on trawl.

Three, 72, 36, and 35 mm. (without caudal fins).

S.R. 331 (see above.)—Sprat net on trawl.

One, 36 mm. (without caudal fin).

S.R. 333.—11-5-'06. 51° 37′ N., 12° 9′ W. Temperature at 500 fathoms, 9·2°C. Sprat net on trawl, 557-579 fathoms.

One, 47 mm. (without caudal fin).

S.R. 352.—5-8-'06. 50° 22′ N., 11° 40′ W. Soundings 800 fathoms. Temperature 7·33°C. Mid-water otter trawl, 700 to 750 fathoms.

Two, 23 and 22 mm., and three, 9·11 mm. (without caudal fins).

S.R. 363.—10-8-'06. 51° 22′ N., 12° 0′ W. Mosquito net on trawl, 695-720 fathoms.

Five, 19-13 mm. (without caudal fins).

The types of *A. Giardi*, two small specimens, were taken by the *Caudan* in the Bay of Biscay at 437 and 776 fathoms. The *Talisman* or *Travailleur*, as we have seen, probably got at least one example of the species within the area covered by Vaillant's records of *A. rostratus*. On the west coast of Ireland *A. Giardi* cannot be common, in adult form, on grounds of less than about 350 fathoms, and seems to be somewhat less abundant on deeper grounds than *A. rostratus*. Larvae and very young forms, apparently referable to *A. Giardi*, have been taken somewhat frequently by the *Helga*, as appears above, and it may be that the habits of this species when adult render it somewhat less susceptible to capture in the trawl than the other. The *Michael Sars* obtained her six specimens north-west of the Hebrides and south-west of Färö in soundings of about 400 to 650 fathoms.

If *A. Giardi* proves to be a synonym of *A. Bairdi*, the species occurs also on the west side of the Atlantic (Newfoundland Banks, 200 fathoms).

It would seem from the *Helgas* records that the vertical range of *A. Giardi* is similar at all stages of which we have cognisance. The three hauls in which young specimens of over 35 mm.

long occurred were all in the neighbourhood of grounds on which the adult has been taken, and adults were actually present in the trawl in two out of these three hauls. When the nature of the net used is taken into consideration it seems reasonable to presume that the habits of the adult have been assumed by the time that a length of 35 mm. or thereabouts is attained.

At smaller sizes, specimens from 19 to 23 mm. long occurred on two occasions in nets attached to the trawl (adults being taken on neither such occasion), and once in a mid-water net fished about 50 or 100 fathoms above the bottom, in company with much smaller specimens apparently referable to the same species.

ALEPOCEPHALUS MACROPTERUS, Vaillant (1888).

Pl. V, Fig. 1.

Conocara macroptera, Goode and Bean (1895).

Form (in specimens of 203 mm. upwards without the caudal fin) elongate, compressed: greatest height of body (at shoulder) about $6\frac{2}{3}$ to $6\frac{3}{4}$ in total length without caudal fin. Upper surface of head and preanal region of back rather flattened. Length of head with gill-cover membranes about $3\frac{3}{4}$ in total length without caudal fin; hind margins of gill-cover membranes rounded. Horizontal diameter of orbit about $\frac{2}{3}$ of length of snout and about 4 to $4\frac{2}{3}$ in length of head. Eye large, partly occlusible by a fold of skin. Width between supraorbital ridges opposite middle of eye about $\frac{4}{5}$ of horizontal diameter of orbit. Interorbital space nearly flat. Snout rather narrow, depressed, obtusely pointed in dorsal view. No depression at nape. Jaws subequal, or with the upper slightly projecting. Maxilla hardly reaching vertical from front margin of orbit. Teeth as in *A. rostratus* and *A. Giardi*, but somewhat more widely separate. Vent at slightly in front of middle of total length without caudal fin. Pectoral fins as long as or longer than snout, their bases at some distance from gill-cover membranes. Ventral fins as long as or longer than orbit, reaching slightly beyond vent, their bases set considerably in front of middle of total length without caudal fin. Dorsal fin commencing far behind vertical from anus; length of its base about equal to its distance from vertical of origin of central caudal rays; with about 19 to 21 rays, of which the first few are small and more or less masked by skin and scales. Anal fin commencing at a noticeable interval behind anus; its base about twice as long as, and extending beyond, that of dorsal fin, with about 37 to 40 rays. Caudal fin deeply forked, anterior rays extending forward above and below peduncle more than half way from origin of central rays to vertical from end of base of dorsal. Height of caudal peduncle about $4\frac{1}{5}$ to $4\frac{1}{2}$ in length of head; its length measured from vertical of end of base of dorsal to origin of central caudal rays about $1\frac{1}{2}$ to 2 in length of head.

Scales minute, rather longer than broad, in about 194 to 222 transverse rows between head and origin of central caudal rays, and about 20 to 24 longitudinal rows above, and about 36 rows below lateral line; present on all parts of the body (except behind base of pectoral fin and on a part of the axillary region), and on the bases of the median fins. Colouration practically uniform black, head deep velvety black with blue iridescence, body purplish black, extremities of median fins brownish grey. Size reaches 330 mm. The eye actually fills the orbit to the extent usual in the genus, but considerably more of its external surface is clothed with skin than in *A. rostratus* and *A. Giardi*. The edge of the skin is moreover in the form of a fold, at least dorsally, where it can be expanded in such a way as to occlude much of the upper half of the normally exposed part of the eye. It would be rash to assume that this provision is indicative of vertical movements on the part of the fish through strata materially differing in circumstances of illumination by atmospheric or other light. The nostrils are immediately in front of the orbit, as shown in Vaillant's figure. His text statement that they are midway on the snout shows that he measured the latter, for this purpose, from the exposed part of the eye. *A. Macdonaldi* (Goode and Bean) appears to be chiefly distinguished from *A. macropterus* by the relatively higher body and larger head, respectively described as $5\frac{2}{3}$ and $3\frac{1}{3}$ in the total length without the caudal fin. Its sponsors appear to have had the opportunity of comparing it with a specimen of *A. macropterus* of practically identical size.

Five specimens, measuring 235 to 330 mm., were taken in the *Helga's* trawl, and in nets attached thereto, at the following station:—

S.R. 335.—12-5-'06. 51° 12′ 30″ to 51° 17′ 30″ N., 12° 18′ to 12° 16′ W. 893 to 673 fath. Temperature at 700 fathoms a few miles away, 6·84° C., salinity, 34·99 °/₀₀.

Vaillant records 16 specimens from the Canaries, coasts of the Soudan and Morocco, and the Banc d'Arguin, at depths of 473 to 1,156 fathoms. None were taken in the Bay of Biscay by the *Caudan*, and none have been recorded in the lists of fishes taken by the *Hirondelle* and *Princess Alice*. Our record above is the only indication of the existence of the species further north on this side of the Atlantic. A specimen was taken by the *Albatross* at 16° 54′ N., 63° 12′ W., the depth being 687 fathoms.

[1] Vaillant gives the colour of the body as reddish brown, but must have taken his description from a specimen more or less denuded of the dark epidermal covering of the scales.

Measurements, in millimetres, and Numbers of Rows of Scales and Fin Rays in Irish specimens of *Alepocephalus*.

—	A. rostratus							A. Giardi.				A. macropterus.	
Station number, series S.R., ..	327	327	331	327	327	330	331	—	331	365	331	335	335
1. Sex, ...	—	♂	♀	♀	♀	♀	♂	♂	♂	♂	♀	—	♂
2. Total length, ...	260+	491	526	556	552	560	555	—	588	652	825+	232	280
3. Total length without caudal fin ..	220	415	440	465	468	473	473	378	522	560	730	203	243
4. Length of head, including skin of gill-cover.	70	122	124	133	131	127	125	107	133	149	187	56	67
5. Length of snout	18	30	31	31	28	28	31	20	26	28	32	18	25
6. Horizontal diameter of orbit. .	20	31	31	36	34	31	33	26	34	38	37	12	17
7. Width between supra orbital ridges opposite centre of eye.	12	23	23	24	24	26	23	23	25	31	35	10	13
8. Snout to origin of dorsal fin, .	147	*	*	*	*	*	*	250	347	365	480	143	173
9. Snout to anus, ...	161	295	305	323	321	320	328	241	345	364	482	105	123
10. Snout to ventral fin, ...	114	220	227	243	240	241	243	181	266	258(?)	365	96	113
11. Height of head at eye, ...	30	55	60	69	61	62	61	41	55	63	70	13	21
12. Height of body, ...	48	83	114	114	97	128†	111	60	87	98	125	26	37
13. Length of pectoral fin. ...	—	45	55	50	60	57	58	38	br.	br.	br	28	27
14. Length of ventral fin, ...	25	30	44	40	50	48	47	br	br.	br	br.	15	17
15. Height of caudal peduncle, ...	17	35	37	41	37	47	38	35	44	46	60	13	15
16. Length of caudal peduncle between vertical from hind end of dorsal fin and origin of central caudal rays.	31	62	64	64	76	77	72	50	105	122	146	31	33
17. Scales above lateral line, ...	*	8	9	9 or 10	8	9	6	ca. 6	7	8	8	—	ca. 24
18. Scales crossing lateral line between head and origin of central caudal rays.	ca. 50	51	54	ca. 54	51	53	52	ca. 66	60	66	65	—	ca. 104
19. Scales below lateral line, ...	?	10	14	11	10	13	10	ca. 9	9	10	10	—	ca. 36
20. Dorsal fin rays	21	18‡	18‡	18‡	20‡	18‡	17‡	ca. 18	21	20	21	ca. 10	10
21. Anal fin rays.	23	24	22	21	21	20	21	25	26	23	24	38	37

* Impossible to measure exactly in large individuals of this species. [illegible] † Height perhaps slightly increased by pressure during preservation. [illegible]

GENUS *BATHYTROCTES*,[1] Günther.

In general characters similar to *Alepocephalus*, but differing in the presence of teeth on the maxilla, in (constantly?) having seven branchiostegals, and in having the dorsal fin equal to or longer than the anal, and originating in front of or opposite to it.
Deep-sea fishes with a range similar to that of *Alepocephalus*.

BATHYTROCTES ROSTRATUS, Günther.

Pl. IV, Figs. 3, 4, 5.

B. rostratus, Günther (1878 and 1877), Goode and Bean (1895), Koehler (1896)[2], Brauer (1906).
Bathytroctes (?), Scharff (1891).
B. proroscopus, Brauer (1902).

This species has not yet been taken by the *Helga* in the adult condition, but larvae and young specimens taken by her on several occasions seem undoubtedly referable to the genus, and, although it might be difficult to refer such specimens to any species without further evidence, a specimen of *B. rostratus* taken by the *Valdivia* and figured by Brauer (1906), which, at a length (without caudal fin) of about 80 mm., still shows a vestige of the supra-clavicular process, hereinafter mentioned, in the shape of a small papilla, serves to connect them with the adult of *B. rostratus*, with which they also agree in the number of fin-rays and in possessing forwardly-directed teeth on the premaxilla.

The smallest specimen taken by the *Helga* is 10 mm. long (without caudal fin), and has the general appearance shown in fig. 3. The eye is about equal in length to the snout, and is contained about 3½ times in the head, which is itself contained 3 times in the total length without caudal. The maxilla reaches to about the level of the centre of the eye, and bears a few teeth set at rather wide intervals. The premaxilla and mandible are toothed. The pectorals are very small, ventrals not yet apparent. The specimen is damaged, but appears to have had a persisting

[1] Goode and Bean divide this genus into two sub-genera, to one of which they apply the name *Talismania*; the two sub-genera, founded upon the relative positions of the dorsal and anal fins, are not at all clearly distinguished from one another, and the lack of substantiality in the division is shown by the fact that *B. rostratus* is placed in one sub-genus and Vaillant's *B. homopterus* in the other. Whether or no the last-named author was right in identifying his *B. homopterus* with *B. rostratus*, the two certainly agree very closely in the relative positions of the dorsal and anal fins. To make *Talismania* a substantive genus, as is done by Jordan and Evermann, seems perfectly unjustifiable.

[2] Although Vaillant himself identified his *B. homopterus* as a specimen of *B. rostratus* we are by no means sure that such identification was correct, and it seems best to follow Koehler in regarding the two forms as provisionally distinct.

larval marginal fin of about the extent shown in our sketch. In colour it is dark sepia on the lower part of the head and abdomen, and elsewhere pale fawn. The most striking character, however, of the fish is a darkly pigmented backwardly and upwardly directed process, possibly tubular, situate apparently upon the supra-clavicle etc. (though we have been unable to ascertain this); the nature and function of this process we are unable to suggest, but it seems to disappear entirely long before the fish has attained its full growth.

A slightly more advanced stage is represented by three rather damaged specimens, 13-14 mm. long (without caudal fin), one of which is shown in fig. 4. Beyond the ordinary changes associated with growth these show no points of difference from the smaller specimen, but the protruding premaxillary teeth can just be detected. The outline of fig. 4 was drawn from a specimen in which we suspect that the head may have been crushed laterally.

A specimen, 27·5 mm. long (without caudal), is in bad condition, but appears to agree in all material respects with the specimen next mentioned.

The largest *Bathytroctes* yet taken by the *Helga*, 32 mm. long (without caudal fin), is shown in fig. 5; this specimen, save for the loss of its epidermis and larval marginal fin, is in very good preservation.

The eye slightly exceeds the snout in length, and its length is contained about three times in the length of the head, which is itself contained just over three times in the total length (without caudal). The maxilla extends nearly to the level of the centre of the eye, and bears minute teeth, with larger teeth at intervals; the premaxillae are somewhat protruding, and each bears three or four forwardly directed teeth, of which the inner are the longer. The supra-clavicular process is darkly pigmented, and nearly as long as the exposed diameter of the crystalline lens. Figure 5 and the table of measurements sufficiently show the form and proportions of this little fish, whose head, except (the dorsal part of the postorbital region) and abdominal region are black, while elsewhere the colouration is brownish-grey. The epidermis is gone, and no sign of scales can be detected; the myomeres number about 38.

The specimens above described were taken as follows:—

S.R. 139.—11-8-'04. 55° N., 10° 48′ W., soundings $\overline{1,\dot{0}00}$ fath.
Triangular net, 1,000 fath.
One, 13 mm. *ca.*

S.R. 193.—10-2-'05. 54° 50′ N., 10° 30′ W., soundings $\overline{\dot{6}50}$ fath.
Triangular net, *ca* 650 fath.
One 10 mm.

S.R. 224.—12-5-'05. 53° 7′ N., 15° 6′ W., soundings $\overline{\dot{8}60}$ fath.
Mid-water otter trawl, 650-750 fath.
Three, 32, 27·5, and 14 mm.

S.R. 282.—18-11-'05. 54° 59′ N., 10° 53′ W., soundings $\overline{1,\dot{0}00}$ fath.
Triangular net, 700 fath. Temperature, 9° C.
One, 13·5 mm.

The known range of *B. rostratus* includes the Atlantic, off Pernambuco, soundings 675 fathoms (Günther, 1887); Banc d'Arguin, Soudan, soundings 600 fathoms (Vaillant, 1888); Bay of Biscay, 46° 28′ N., 7° W., soundings 940 fathoms *ca.* (Koehler, 1896), and off the west coast of Ireland. Also the Indian Ocean, in nets fished at 820 to 1,080 fathoms *ca.* over soundings of 1,850 to 2,770 fathoms (Brauer, 1906).

The available evidence points to a vertical range of at least 600-1,100 fathoms, and the young stages up to 80 mm. long are certainly normally found at such depths over considerably deeper soundings both off the Irish coast and in the Indian Ocean. Whether they are also found on or near the bottom in suitable soundings, and whether larger specimens live normally on the bottom, it is impossible to say. The largest recorded specimen was only 165 mm. long (including caudal fin), and the species in all probability attains a considerably larger size, as may be inferred from a comparison of its young with those of *Alepocephalus* at comparable stages of development.

MEASUREMENTS, in millimetres, and Fin-ray formulae of Specimens from S.R. 224.

—	*a.*	*b.*	*c.*
Length without caudal fin, ...	14	27·5	32
Length of head, ...	4·5	9·5	10·5
Length of snout, ...	1·5	3	3·25
Length of orbit, ...	1·5	3	3·5
Interorbital width, ...	—	1·5	2
Length of maxilla, ...	—	4·5	5
Length to origin of dorsal fin, ...	8·5	17	18·5
Length to origin of anal fin, ...	9·5	18	20
Depth of head, ...	—	4·75	5
Depth of body at ventrals, ...	—	2·25	3
Depth of caudal peduncle, ...	—	1·5	2
Dorsal fin-rays,*	17 *ca.*	17 *ca.*	17
Anal fin-rays,* ... —	18 *ca.*	18 *ca.*	18

* Including other specimens, too damaged to permit of full measurements being given, the fin-ray formula is—D. 17-19 *ca.*, A. 17-20 *ca.*

GENUS *XENODERMICHTHYS*, Günther.

Form elongate, more or less compressed. Snout more or less obtuse, never long. Skin thick, sometimes longitudinally wrinkled, scaleless or with only rudimentary, non-imbricating scales, except sometimes in the lateral line. Numerous small papillae or nodular photophores, generally distributed, but usually without definite linear arrangement, on head and

body. Lateral line indistinct, without conspicuous scales or distinct, with more or less conspicuous and perfect scales. Small teeth on premaxillae and mandibles and usually on maxillae; (probably) none on vomer, palatines and tongue. Dorsal and anal fins of equal or nearly equal length, and opposite or nearly opposite to each other. Caudal fin forked. Ventral fins near anus behind middle of total length.

Gill (1884), Goode and Bean (1896), Jordan and Evermann (1896-98), and Brauer (1906) divide the genus, as we understand it, into *Xenodermichthys* and *Aleposomus*, referring *X. nodulosus*, Günther, to the former and all other species to the latter. The most obvious reason for this division seems to be that *X. nodulosus* has a smaller mouth and eye than any other species, and to us it appears that *X. socialis* is less remote from *X. nodulosus* than from such as *A. lividus*, Brauer.

XENODERMICHTHYS SOCIALIS, Vaillant (1888).

Pl. V, Fig. 2.

Xenodermichthys socialis, Collett (1896), Koehler (1896).

Aleposomus socialis, Goode and Bean (1896), Brauer (1906).

Form compressed, elongate. Height of body (subequal from pectoral region to origins of dorsal and anal fins) about $5\frac{3}{4}$, length of head about 4 to $4\frac{1}{4}$, bases of dorsal and anal fins about $3\frac{1}{2}$ to $3\frac{3}{4}$ in total length without caudal fin. Snout obtuse, much shorter than horizontal diameter of orbit, which is about $2\frac{1}{2}$ or $2\frac{3}{4}$ in length of head. Lower jaw slightly protruding, maxilla reaching beyond vertical from front margin of crystalline lens. Minute teeth present on premaxillae, maxillae (few) and mandibles; none on palatines, tongue and pterygoids. Anus a little nearer to insertion of pectoral fins than to origin of central caudal rays. Pectoral fins slender, set rather low on body. Ventral fins set a little in front of middle of total length without caudal fin.

Dorsal fin low, with about 27 to 29 rays. Anal fin opposite and similar to dorsal, with about 27 or 28 rays. Caudal fin deeply forked. Skin (in perfect examples) longitudinally wrinkled, set with numerous very minute papillae representing scales, and with small tubercular photophores generally distributed over head and body. Lateral line indistinct. Colouration deep velvety black. Size exceeds 147 mm.[1]; female mature at 132 mm.

The lateral line becomes fairly distinct and somewhat tubular in appearance if a well-preserved specimen is allowed to become slightly dry.

[1] The type cited by Vaillant measured 147 mm., or 130 mm. without the caudal fin. Our largest specimen measures 134 mm. without the caudal fin.

Among the large-eyed species which we should refer to *Xenodermichthys* (*Aleposomus* spp. of Goode and Bean and Brauer) all except *X. Copei* (Gill, 1884, Goode and Bean, 1896), appear to have no more than about 20 rays in either dorsal or anal fin, and in this way can be distinguished from *X. socialis*, which has about 27, very difficult to count exactly without injuring the skin. The radial formula of *X. Copei* is not stated, but Mr. Todd, who is usually accurate, depicts D. 27, A. 27 in Goode and Bean's figure. The species, however, seems to taper rather regularly in height from the shoulders to the caudal peduncle, and in this way differs from *X. socialis*. *X. nodulosus* has the eye very much smaller than any other known species, and has more than 30 rays in both dorsal and anal fin.

The characters of the skin which we have noted above are not of very much account in the determination of species, because much depends upon the condition of the specimen. The plications of the skin disappear rather readily if the fish is chafed in the net, and more or fewer of the photophores may be rubbed off without leaving conspicuous traces. Even when perfect they look more like small nodules or tubercles than photophores. The tiny structures which represent the rudiments or vestiges of scales are hardly visible without magnification, and were in fact overlooked by Vaillant in his types, though found in one of them by Collett.

The diagnosis which we have given refers to specimens of adult form. A rather badly mangled fish of 20 mm., without caudal fin, seems to be a young member of this species, with which it agrees in general conformation, allowing for differences, such as the large size of the head, due to age. The eye is about $2\frac{1}{2}$ in the head and longer than the snout, the length of the head about $3\frac{1}{4}$ in the total length (without caudal). The greatest height of the head, about equal to the length of the eye and snout, is more than half of the length of the head and more than twice the height of the caudal peduncle. The height of the body tapers gradually from the head to the caudal peduncle. The dorsal and anal fins are not in good condition, but do not differ materially in extent and position from those of the adult. Their formulae are illegible.

Whether naturally or as the result of abrasion in the net the photophores are almost wholly confined to the ventral parts. As compared with those of the adult they are relatively large and look much like those of some *Scopeli* (e.g. *S. crocodilus*, *S. glacialis*) at a similar size, but are not brilliant as in the young of *S. punctatus*. Moreover, they show some attempt at regularity of arrangement. They form a border external to the lower half of the periphery of the eye, and are rather closely set on the isthmus and neighbouring parts of the gill-cover. Between the head and the ventral fins they are scattered over most of the surface below the region of the lateral line. Behind the ventral fins they become more confined to the lower edge of the body, forming a band, irregularly treble or double, as far back as the middle of the anal fin, whence they are continued as

a single row on each side of the ventral edge to the origin of the caudal fin. The head (except the upper post-orbital part) and the belly are black: elsewhere the colour, after preservation, is brown, thickly dotted with black chromatophores.

MEASUREMENTS, in millimetres, and approximate number of Fin Rays in a specimen from S.R. 299.

Total length without caudal fin	134 mm.
Length of head	32 ,,
Length of snout	5 ,,
Horizontal diameter of orbit	11 ,,
Width between supra-orbital ridges opposite centre of eyes	5 ,,
Snout to dorsal fin	80 ,,
Snout to anal fin	81 ,,
Snout to base of ventral fins	64 ,,
Length of base of dorsal fin	40 ,,
Length of base of anal fin	40 ,,
Length of pectoral fin	16 ,,
Length of ventral fin	14 ,,
Height of body at origin of pectoral fin	24 ,,
Height of body at anus	24 ,,
Height of caudal peduncle	10 ,,
Length of caudal peduncle between verticals from hind end of base of dorsal and origin of central caudal rays	15 ,,
Number of dorsal rays	ca. 28 ,,
Number of anal rays	ca. 28 ,,

Our material was obtained as follows :—

S.R. 299.—4/5-2-'06, 50° 13′ 30″ N., 11° 16′ W., soundings 500 fathoms, ooze. Temperature at 370 fathoms 10·8° C., at 470 fathoms 9·7° C.

One, 134 mm. (without caudal fin), taken in a trawl which failed to reach the bottom and captured nothing else except a big *Stomias boa*.

S.R. 351.—5-8-'06, 50° 19′ 30″ N., 11° 6′. W., 230 to 250 fathoms, fine sand. Temperature at 245 fathoms 10·1° C.

One, 20 mm. (without caudal fin), taken in a bag of mosquito net attached to the back of the trawl.

We have also a specimen taken by Dr. Schmidt in the *Thor* at 49° 23′ N., 12° 13′ W.

X. socialis is otherwise known from the north-west coast of Africa to the Banc d'Arguin (20° N.), 392 to 740 fathoms; Azores, 380 fathoms; Bay of Biscay, 1,200 fathoms. The *Talisman* and *Travailleur* took it in seven hauls, one specimen in each of six hauls, and 133 in the remaining haul, from which Vaillant considers that it may be a gregarious species. The first *Helga* record suggests that it is not wholly a ground fish, though the trawl on that occasion must have been very near the bottom.

iv.—Recent Additions to the British-and-Irish List.

The restoration to the list of *Bathytroctes rostratus* is noted above (p. 45). Other fishes, which have been only taken or recognised since our first report was published, are—

Pristiurus murinus, Collett.
Raia bathyphila, sp. n.
Raia sp.
Microstoma sp. (young).
Argyropelecus Olfersi (Cuv.).
Sternoptyx diaphana, Hermann.
Scopelus Humboldti, Risso.
Scopelus sp.
(?) *Paralepis pseudocoregonoides*, Sarato.
Notacanthus rostratus, Collett.
Bathygadus melanobranchus, Vaillant.
Lyconus brachycolus, Holt and Byrne.
Halargyreus affinis, Collett.
Laemonema latifrons, Holt and Byrne.
Gargilius sp. (Jenson *fide* Schmidt).
Melamphäes megalops, Lütken.
Cyttosoma Helgae, Holt and Byrne.
Cottunculus Thomsoni, Günther.
Oneirodes megaceros, Holt and Byrne.

We add a note about some specimens of the genus *Crystallogobius* which may possibly be distinct from *C. Nilssoni.* They were taken in the Irish Sea.

Fam. *SCYLLIIDAE.*

PRISTIURUS MURINUS, Collett (1904).

Pristiurus murinus, Collett (1905).

S.R. 483.—30-8-'07. 51° 37′ N., 11° 56′ W., 610 to 664 fath. trawl. Temperature at 546 fath. 8·34 C. Salinity 35·32°/₀₀.
One adult male, 378 mm.

The type, a young example of 225 mm., was taken by the *Michael Sars* north-west of the Hebrides at about the same depth.

Fam. *RAIIDAE.*

RAIA BATHYPHILA sp n.

S.R. 335.—12-5-'06, 51° 12′ 30″ N., 12° 18′ W. to 51° 17′ 30″ N. 12° 16′ W., 893 to 673 fathoms. Temperature at 700 fathoms, 6·84° C., salinity 34·99 °/₀₀
One, 101 mm. across disk.

The specimen is quite immature, but as some of its characters are of a nature not likely to be altered beyond recognition with growth, it may be used as a type.

Its nearest relative appears to be *R. isotrachys*, Günther (1887) known from a specimen taken by the *Challenger* south of Japan at 365 fathoms.

PRINCIPAL MEASUREMENTS.

Width of disk	101 mm.
*Length of disk	88 „
Total length	184 „
*Pre-ocular length	22 „
Length of eye	7 „
Distance from front edge of eye to hind edge of spiracle	9·5 „
Width of inter-orbital space	7 „
Length of tail from hind insertions of ventral fins	98 „
Length of part of tail occupied by median fins	25 „
Preoral length, measured to centre of nasal valves	26 „
Preoral length, measured to centre of gape	29 „
Width between nostrils	13·5 „
Width of exposed part of mouth	11 „
Snout to coracoid	45 „
*Snout to angle of pectoral fin	58 „

The measurements marked (*) are taken from the snout to the point where lines between hind margins of disk, front margins of eyes and angles of pectoral fins, respectively, cross the long axis of the body.

Anterior margins of disk only slightly undulated, forming, by lines drawn from lateral extremities of pectoral fins to tip of snout, a general angle of about 88·5°. Angle of snout, from extremities of a line (measuring 55 mm. in the type), drawn across disk through anterior margins of eyes, about 102°. Extremity of snout rounded. Angles of pectoral fins broadly rounded, their lateral extremities nearer to the hind end of the disk than to the snout. Teeth small and bluntly pointed, about 36 rows in the upper jaw. Lips without conspicuous papillae or fimbriation. Buccal region defined posteriorly by a conspicuous fold of skin. Dorsal and caudal fins confluent by means of narrow membranes. Dorsal surface (except a narrow border along anterior and a rather wide border along posterior margins of disk, and part of ventral fins) set with small, slender, backwardly directed thorn-like spinules, each supported by about four radiating basal processes, and, on the disk, distributed at intervals about equal to their length. Orbital spines, [1] one in front and two behind the eye on each supraorbital ridge. Humeral spines, three in a median line from the head to the shoulder girdle, and two at each extremity of the latter, the outermost smaller than and slightly posterior to the others. Linear spines, thirty in a single median row from the shoulder to the first dorsal fin; some of the

[1] The structures here described as spines have swollen bases, but no radiating basal processes.

spinules on the sides of the tail larger than the rest and with somewhat swollen bases. Ventral surface smooth, except at the edges of anterior part of tail. Dorsal colouration' cold sepia, appearing ashy-brown by reason of the spinules. Ventral colouration brown, except the front of snout, mouth parts and belly.

These notes must be taken as a brief description of the stage of growth under observation, and not as a diagnosis of the species. In older specimens the general shape of the disk will probably be found to remain much the same, save for minor undulations of the disk in adult males. The tail probably becomes relatively shorter, the teeth certainly more numerous and, in males, more sharply pointed as growth proceeds. The spinulation of the dorsal surface is not likely to undergo much alteration, but spinules may appear on the anterior margins of the ventral surface; and adult males may probably have the spinules of the dorsal anterior margins enlarged and the general spinulation of the dorsal surface reduced, and will, of course, have the usual rows of depressed, inwardly directed spines on the pectoral fins. The orbital and humeral spines may become obsolete in adults, but in intermediate stages there may be found (as indicated by enlarged spinules in the specimen before us) a row of six or eigth small spines on either edge of the rostrum. The linear median spines will probably be replaced, as growth proceeds, to a greater or less extent by the intercalation of new spines in the same line as the present series becomes obsolete, but old specimens may have few or only small spines in front of the pelvic region. There may possibly be a single series of lateral spines on each side of the tail, not large at any stage of growth, and almost certainly obsolete or absent in adult males. The dorsal colouration is not likely to alter, but the dark colour may disappear from the ventral surface, or, on the contrary, may invade the whole.

RAIA sp.

A ray measuring about 230 mm. across the disk, taken at the same station as *P. murinus*, has a general resemblance to *R. circularis*, Couch (*sensu stricto*). It is, however, armed with much more formidable spines and lacks the white spots of the back. Some dark pigment is present ventrally.

Fam. *SALMONIDAE*.

MICROSTOMA sp.

S.R. 231.—20-5-'05, 50 miles *ca.* N. by W. of Eagle Island, 55° 1′ N., 10° 45′ W., soundings 1,200 fath. Mid-water otter trawl at 1,150 fathoms.

Several. 10-12 mm. *ca.* (without caudal).

S.R. 337.—12-5-'06, 51° 19′ 30″ N., 12° 9′ 30″ W., soundings 768 fathoms.

Mid-water otter trawl at 1-20 fathoms.
One 14·5 mm. (without caudal).

The specimens are too small for specific determination, but may be *Microstoma groenlandica*, Reinhardt (1841).

FAM. *STERNOPTYCHIDAE*.

STERNOPTYX DIAPHANA, Hermann.

S.R. 481.—29-8-'07, 50° 59′ N., 11° 52′ W., soundings 920 to 1,064 fathoms, mid-water otter trawl fished at about 600 to 900 fathoms, and to the surface
One, 45 mm. without caudal fin.

ARGYROPELECUS OLFERSI (Cuvier, 1829)

Argyropelecus Olfersi, Brauer (1906).

S.R. 302.—5-2-'06. 52° 54′ N., 11° 54′ W., soundings 460 fathoms. Mid-water otter trawl at 300-350 fathoms. Temperature at surface, 10·5° C., salinity 35·37°/$_{oo}$; at 250 fathoms, 10·22° C., 35·37°/$_{oo}$; at 350 fathoms, 9·91° C., 35·34°/$_{oo}$.
One, 38 mm.

S.R. 470.—24-8-'07, 56° 16′ N., 11° 27′ W., soundings 770 fathoms, mid-water otter trawl at 400 to 500 fathoms. Temperature at surface 15·8 C., salinity 35·30°/$_{oo}$; at 500 fathoms, 9·03 C., 35·35°/$_{oo}$.
One, 36 mm.

We are indebted to Mr. Regan for naming the first specimen, and for demonstrating the characters which appear to avail at all stages to distinguish this species from the common form of our area, *A. hemigymnus*.

The Irish records add little to the knowledge of distribution, since *A. Olfersi* is already known from the coasts of Norway and Portugal, but it is interesting to note that while off the Irish coast the *Helga* collects *A. hemigymnus* in considerable number and at all stages of existence, she has only taken two rather large specimens of *A. Olfersi*.

The last-named species ranges in the Atlantic from the North Cape to the Cape of Good Hope on the eastern side, and has occurred also off the coast of North America and in mid-ocean towards Brazil. In the Pacific it is known from the Indian Ocean, Gulf of Panama, and perhaps from off China (cf. Brauer, 1906).

Fam. *PARALEPIDAE.*

(?) *PARALEPIS PSEUDOCOREGONOIDES*, Sarato (1887).

S.R. 440.—16-5-'07, 51° 45′ N., 11° 49′ W., soundings 350–389 fathoms. Trawl. Temperature at 300 fathoms, 9·93°C. Salinity 35·46°/$_{oo}$.

One, 214 mm. (without caudal fin), found in the stomach of a silver ling (*M. abyssorum*, Nilss.).

The specimen is not in a condition for exact specific determination, but is almost certainly identical with the macerated specimens which Collett (1897) doubtfully refers to *P. pseudo-coregonoides*.

Paralepis proves to be the parent of a larva which has long puzzled us. It is a very elongate form, with head and mouth suggesting *Paralepis*, and with an unusually precocious and relatively large anal fin immediately in front of the caudal. The anus, however, is very near the head (as, in adults of similar form, only in *Ipnops*) and it retains this position until the fish reaches a size considerably greater than that at which metamorphosis in this particular might be expected to have been achieved. Recent acquisition of older stages undoubtedly assigns the larva to *Paralepis*, as we shall show in a later communication.

Fam. *SCOPELIDAE.*

SCOPELUS HUMBOLDTI (Risso, Lütken, 1892).

S.R. 302.—5/6-2-'06, off Tearaght Light, Co. Kerry, 51° 54 N., 11° 54′ W., soundings 460 fathoms, mid-water otter trawl at surface. Temperature 10·5°C., salinity 35·39 °/$_{oo}$.

One, 33·5 mm.

This record has already been mentioned, without particulars in a correction slip sent out with *Fisheries, Ireland, Sci. Invests* 1905, *II.* [1906], and in a note added to the reprint of the same paper in *Pt. II.* of the *Annual Report on the Sea and Inland Fisheries of Ireland for* 1905 [1907], *App., No. II.*, p. [53].

The species is known from both sides of the Atlantic and (cf. Brauer, 1906) from the Pacific. Its capture by the *Helga* extends the range northwards from the Bay of Biscay (Koehler, 1896) to Ireland. On the American side we do not know of a record reaching 37° N.

SCOPELUS sp.

S.R. 364—10-8-'06, 51° 23′ 30″, 11° 47′ W., 620 to 695 fathoms, ooze. Trawl. Temperature at 600 fathoms, 7·92° C.

One, 77 mm., without caudal fin.

The specimen is very much mangled, and all that can be said of it with certainty is that it is specifically different from any form known as an inhabitant of the British-and-Irish area. Probably it may belong to the section *Lampadena*, defined as a genus by Goode and Bean (1896), but of the photophores none are extant except three of a thoracic, and perhaps two of a pectoral series. They are relatively small and, even with due allowance for the condition of the specimen, may be called deciduous. The head is apparently destitute of large luminous organs. There is a narrow ovoidal luminous patch on the dorsal side of the caudal peduncle, and on the ventral side is a similar but larger patch about as long as the eye.

The eye is much longer than the snout. The latter is blunt and abrupt, and slightly carinate in the middle line. The supra-orbital ridges are strongly developed, with a well-marked (but hardly spinous) posterior projection. There is a small backwardly directed spine above the dorsal origin of the pre-opercular keel, which is oblique and terminates ventrally at a point which is separated from the eye by a distance about equal to a diameter of the eye taken in the same line.

36 or 37 scales cross the lateral line, and in a transverse series there are four above and six below the lateral line in front of the anal fin, and five below the line at the anal fin. Though most of the scales are missing the formula is reasonably legible from the pouches. The few scales which remain are thin, cycloid, not lustrous. The dorsal fin commences at the same vertical as the ventrals and has 13 rays, the last bifid to its base. The anal commences behind the vertical from the end of the base of the dorsal, and now exhibits 10 rays, but some part of its middle is missing. Its base is about as long as the distance from its last ray to the anterior ventral ray of the caudal fin.

The subjoined dimensions may have been to some extent modified by laceration of the body, so as to present a relatively less length and greater height than in normal.

Total length without caudal fin		77 mm.
Length of head		24 ,,
Length of snout		2 ,,
Horizontal diameter of eye		8 ,,
Width between supra-orbital ridges	At anterior extremities	5 ,,
	At posterior extremities	11 ,,
Snout to ventral end of pre-opercular keel		18 ,,
Snout to first dorsal ray		31·5 ,,
Snout to first anal ray		45 ,,
Length of caudal peduncle (ventral)		16·5 ,,
Length of base of dorsal fin		11·5 ,,
Height of body at first dorsal ray		21 ,,
Height of caudal peduncle		10 ,,

Colouration brownish black.

Fam. *NOTACANTHIDAE.*

NOTACANTHUS ROSTRATUS, Collett (1889).

S.R. 486.—3-9-'07, 51° 37′ N., 12° 1 W., 600 to 660 fathoms, stones, dredge.
One, *ca.* 310 mm.

S.R. 493.—8-9-'07, 51° 58′ N., 12° 25′ W., 533 to 570 fathoms, trawl.
One, *ca.* 350 mm.

S.R. 499.—11-9-'07, 50° 55′ N., 11° 29′ W., 666 to 778 fathoms, trawl.
One, *ca.*, 320 mm.

S.R. 500.—11-9-'07, 50° 22′ N., 11° 26′ W., 625 to 666 fathoms, mosquito net on trawl. Temperature at 600 fathoms, 8·22 C., salinity 35·41°/₀₀.
One, *ca.*, 290 mm.

S.R. 504.—12-9-'07, 50° 42′ N., 11° 18′ W., 627 to 728 fathoms, fine mesh net on trawl.
One, *ca.* 310 mm.

Collett's type was obtained on the Newfoundland Banks. The British Museum possesses an example from the Cape of Good Hope. Our specimens are undoubtedly referable to Collett's *N. rostratus*, but the synonomy of the species seems to require further consideration.

Fam. *MACRURIDAE.*

BATHYGADUS MELANOBRANCHUS, Vaillant (1888).

Bathygadus melanobranchus, Collett (1896), Brauer (1906).

S.R. 397.—2-2-'07. 51° 46′ N., 12° 5′ W., 549-646 fathoms, Temperature at 500 fathoms, 8·71°C., salinity 35·37°/₀₀
One, 290 mm.

Our specimen was named by Mr. Regan after comparison with one of Vaillant's types. In the Atlantic it has not previously been taken north of the coast of Morocco. In the area bounded by Morocco, the Canaries, and the Azores, its recorded depths are 454 to 851 fathoms. In the Pacific it is known from depths between 141 and 718 fathoms.

LYCONUS BRACHYCOLUS, Holt and Byrne (1906).

S.R. 352.—5-8-'06. 50° 22′ N., 11° 40′ W., soundings 800 fathoms. Mid-water otter trawl at *ca.* 700 to 750 fathoms. Temperature at 700 fathoms, 7·33° C.
One, 237 mm.

The net may have been nearer the bottom than the particulars given above seem to denote, since it caught some bottom-living crustacea.

We have given a full description of the specimen in *Ann. Mag. Nat. Hist.*, S. 7, xviii., pp. 423-426, but on p. 425, in the second line below the table of measurements, the specific name "*L. pinnatus*" was inadvertently written "*L. brevipinnis*."

FAM. *GADIDAE.*

HALARGYREUS AFFINIS, Collett (1904).

Halargyreus affinis, Collett (1905).

S.R. 400.—5-2-'07. 51° 18′ N., 11° 50′ W., 525-600 fathoms. Temperature at 580 fathoms, 8·35° C., salinity 35·50‰. One, 278 mm.

Collett's five types were taken at 600 to 710 fathoms, north-west of the Hebrides, bottom temperature, 8·07° C. (three), and at 410 fathoms south-west of the Färös (two). Therefore of the six specimens known to science four have come from within the British-and-Irish area.

LAEMONEMA LATIFRONS, Holt and Byrne (1908).

S.R. 489.—4-9-'07. 51° 35′ N., 11° 55′ W., 720 fath., trawl. Two, about 140 and 160 mm., the types described in *Ann. Mag. Nat. Hist., Jan.*, 1908.

GARGILIUS sp., Jensen, *fide* Schmidt (1906).

S.R. 439.—15-5-'07. 51° 45′ 30″ N., 12° 31′ W. Soundings 584–723 fathoms. Triangular mosquito net at surface, 11·30 p.m. Temperature, 11·75° C. Salinity, 35·44‰. Several, small.

So far as we are aware Jensen has not yet published a description of this fish, nor given it a specific name. It was discovered by Schmidt in his 1905 cruise in search of eel larvae, apparently on 14-6-'05, at 51° N., 11° 43′ W., soundings 656 fathoms. The depth of the fishing engine is not stated, but appears from the context (Schmidt, 1906, p. 177) to have probably been at some distance from the bottom. Our specimens, though quite small, are evidently of the same species as an example kindly given to us by Dr. Schmidt. It is not represented, except possibly as an insufficiently characterised larva, in any of the earlier *Helga* gatherings, and is in fact confined in record to two stations, both of which are within the Irish section of the 0–1,000 fathom zone.

Fam. *BERYCIDAE.*

MELAMPHAËS MEGALOPS, Lütken (1877).

Melamphaes megalops, Günther (1887), Brauer (1906).
Plectromus megalops, Goode and Bean (1896).

S.R. 439.—15-5-'07. 51° 45′ 30″ N., 12° 31′ W. Soundings 584–723 fathoms. Triangular mosquito net at surface, 11.30 p.m. Temperature, 11·75° C. Salinity 35·44 °/₀₀.
One, 32 mm.

As Brauer shows, the head is nearly smooth in perfect specimens, and not covered with naked ridges and spinous processes as in Lütken's figure of the type.

The latter was obtained from the stomach of a *Coryphaena*, south of the Azores. The *Valdivia* took specimens in vertical nets in the Gulf of Guinea, Bay of Bengal, Gulf of Aden, and off the N.E. coast of Africa. The depths to which the nets were lowered varied from 1,094 to 1,914 fathoms. In the only case in which soundings are given the net was, at its deepest, about 1,676 fathoms above the bottom.

Fam. *ZEIDAE.*

CYTTOSOMA HELGAE, Holt and Byrne (1908).

S.R. 487.—3-9-'07. 51° 36′ N., 11° 57′ W., 540 to 660 fath., trawl. Temperature at 500 fathoms, 8·65° C. Salinity 35·35°/₀₀.
One, 244 mm., the type described in *Ann. Mag. Nat. Hist., Jan.*, '08.

Fam. *GOBIIDAE.*

CRYSTALLOGOBIUS sp.

S.R. 412.—15-2-'07. 53° 46′ 30″ N., 5° 36′ W., soundings 52½ fathoms, townet 25-0 fathoms. Temperature at 25 fathoms 7·11°C., salinity 24·33°/₀₀; at surface 7·25° C., 35·33°/₀₀.

Two, about 14·5 mm. without caudal fin.

These little fishes are too much damaged to afford material for exact diagnosis of characters. They are very like *C. Nilssoni* at the same size, but seem to have the head rather smaller and the mouth shorter and more oblique. The myomeres are about 11 + 19, and appear to have been defined (in the perfect condition) by minute black chromatophores. Similar chromatophores appear to have been generally but rather sparingly distributed

over the body; but it is possible that what seems to be black pigment is merely adventitious dark matter of extraneous origin, adhering to the lacerated skin. The ventral fins are wanting, the pectorals short, the dorsal and anal illegible in fin-ray formula. One of the specimens is a female with ovaries filled with apparently ripe ova.

Excluding the pigmentation as doubtful, these fishes, in any characters which have been preserved, cannot be distinguished with certainty from the young of *C. Nilssoni*, but we have never seen a female, undoubtedly referable to that species, mature at so small a size.

FAM. *COTTIDAE.*

COTTUNCULUS THOMSONI (Günther, 1882).

Cottunculus torvus, Goode (1883).

S.R. 494.—8-9-'07. 51° 59′ N., 12° 32′ W., 550 to 570 fathoms, fine-mesh net on trawl.
One, 40 mm.

S.R. 506.—12-9-'07. 50° 34 N., 10° 19′ W., 661 to 672 fathoms. Temperature at 600 fathoms. 8·22° C. Salinity 35·53.°
One, 114 mm.

This fish occurs in deep water on both sides of the North Atlantic.

FAM. *CERATIIDAE.*

ONEIRODES MEGACEROS, Holt and Byrne (1908).

S.R. 497.—10-9-'07. 51° 2′ N., 11° 36 W., 775 to 795 fathoms, ooze, trawl.
One, about 95 mm., the type described in *Ann. Mag. Nat. Hist., Jan.*, 1908.

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EXPLANATION OF PLATES I to V.

Plate I.

Scorpaena dactyloptera, 410 mm. × ½. Outline, scales somewhat diagrammatic.

Plate II.

Scorpaena cristulata, 504 mm. × ⅓.

Plate III.

Fig 1. *Alepocephalus rostratus*, 553 mm. × ⅓. The scales, which are in part restored, are shown without the natural dark epidermal covering. On the bases of the dorsal and anal fins they are somewhat more pointed in outline and extend somewhat farther on to the rays than is shown in the figure.

Fig. 2. *Alepocephalus Giardi*, 590 mm. × ⅓. The scales which have been restored should be somewhat more pointed in outline.

Plate IV.

Alepocephalus Giardi.

Fig. 1. Larva of 20·5 mm., *Helga*, CXX.
Fig. 2. Larva of 35 mm., outline, S.R. 327.

Bathytroctes rostratus.

Fig. 3. Larva of 10 mm., S.R. 193.
Fig. 4. Larva of *ca.* 14 mm., from two specimens, S.R. 224 and S.R. 282.
Fig. 5. Larva of 32 mm., S.R. 224.
The lines below the figures denote the natural size.

Plate V.

Fig. 1. *Alepocephalus macropterus*, 330 mm. × ⅗, outline.
Fig. 2. *Xenodermichthys socialis*, 147 mm., outline, slightly altered from Vaillant.

NOTE ADDED IN PRESS.

SCORPAENIDAE.

Jaquet ("Considerations sur les Scorpénides de la Mer de Nice," *Bull. Inst. Océanog.*, No. 109, 1907 [1908]) discusses the local species of *Scorpaena* in great detail, and should be consulted as to the characters and affinities of *S. scrofa*. He is especially interested in the generic distinction between *Scorpaena* and *Sebastes*, relegating *S. dactyloptera* to the last named genus. His conclusions, however, read in conjunction with our description of the adult of *S. cristulata*, do not seem to support the exclusion of *S. dactyloptera* from the *Scorpaenae*.

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TO THE SCIENTIFIC PUBLICATIONS OF THE FISHERIES BRANCH OF THE DEPARTMENT OF AGRICULTURE AND TECHNICAL INSTRUCTION FOR IRELAND.

1901—1905.

COMPILED BY

CHARLES GREEN, B.A.

NOTE.—Pages referred to by a *small* Roman numeral belong to the Report of the Scientific Adviser prefixed to Part II of the *Annual Report on the Sea and Inland Fisheries of Ireland.*

Pages referred to by an Arabic numeral will be found, in 1901 and 1902-03, in the Appendix to Part II of the *Annual Report* and in reprints therefrom, and, in 1904 and 1905, in the separate numbers of the series entitled *Scientific Investigations* (indicated by a large Roman numeral), and in the Appendix to Part II of the *Annual Report.* Separate indices will be found in the volumes for 1904 and 1905.

In the Index of Subjects, the year is denoted by dark figures in round brackets.

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ii.—Index of Subjects.

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Appendix, No. VII.

INLAND FISHERIES.

i.—Report on the Artificial Propagation of Salmonidae during the season of 1906-1907, by E. W. L. Holt.

ii.—Statistical Information relating to the Salmon Fisheries.

iii.—Substance of Reports received from Clerks of Conservators relative to Salmon Fisheries.

i.—REPORT ON THE ARTIFICIAL PROPAGATION OF SALMONIDAE DURING THE SEASON OF 1906-1907,

BY

E. W. L. Holt.

I estimate the number of fry turned down in the spring of 1907 at about 6,143,000 salmon, 508,000 white trout, and 344,000 brown trout. The brown trout estimate is, no doubt, below the actual figure, as it is probable that we do not hear of every small transaction in the propagation or importation of this fish. The salmon total comes within about 500,000 of that of the previous season, and is therefore in excess by about the same number of the total of any earlier year. As usual the exertions of Mr. Penrose and Mr. Godfrey at Lismore, and of Mr. FitzHerbert at Black Castle, are largely responsible for high figure of the aggregate.

Some discrepancy between the items and the totals of brown trout in the two years dealt with in the table will be found to be due to transfers from hatchery to enlarging station, deduction being made in the totals for fry which appear in more than one place in the columns. Mr. F. C. Stenning, of the Munster Trout Farm, Innishannon, who is the chief agent in this country for the distribution of trout ova and fry, has been good enough to furnish us with an account of his transactions in such matters, which materially adds to the completeness of the return. In the salmon columns transfers from Rockmills, which is at present the only distributing station for salmon ova, have been deducted from the figure credited to that hatchery. In general the season seems to have been normal for both natural and artificial propagation, or in regard to the latter, of which the success depends upon the capture of spawners, rather on the favourable side. The severe weather of the early part of 1907 does not appear to have been accompanied by such drying of the rivers and streams as renders ova liable to damage by frost, and although

OUTPUT OF SALMON AND TROUT

HATCHERY OR ENLARGING STATION.	River System.	All Salmon.	
		1905-6.	1906-7.
Brittas, ...	Liffey, ...	—	—
Lough Dan, ...	Ovoca, ...	—	—
Newtownbarry, ...	Slaney, ...	95,000	45,000
Inistioge,*	Nore, ...	137,000	137,000
Cahir,*	Suir, ...	140,000	21,000
Lismore,*	Cork Blackwater, ...	2,033,000	2,120,000
Rockmills,*	" " ...	244,000	250,000
St. Ann's, ...	Lee, ...	—	—
Inishannon, ...	Bandon, ...	—	—
Skibbereen, ...	Ilen, ...	35,000	42,000 (e)
Caragh Lake, ...	Caragh, ...	—	—
Killorglin,*	Laune, ...	150,000	148,000
Killarney,*	"	65,000	122,000
Muckross,*	"	50,000	105,000
Ballinruddery, ...	Cashen, ...	35,000	35,000
Adare, ...	Maigue, ...	120,000	—
Kilronan, ...	Shannon, ...	—	—
Lough Sheelin, ...	"	—	—
Costello, ...	Costello	—	—
Screebe,*	Screebe, ...	292,000	309,000
Inver, ...	Galway Inver, ...	15,000	106,000
Aasleagh, ...	Erriff, ...	—	72,000 (g)
Ballysodare, ...	Unshin, ...	65,000	75,000
Bundrowes, ...	Drowes, ...	65,000	150,000
Belleek,*	Erne, ...	336,000	215,000
Glenties, ...	Owenea, ...	38,500	69,000
Dunglow, ...	Dunglow, ...	—	—
Newtownstewart,*	Foyle, ...	692,000	800,000
Kilrea,*	Bann, ...	560,000	469,000
Lough Neagh, ...	"	—	—
Black Castle,*	Boyne, ...	1,660,250	843,000
TOTALS, ...	—	6,827,750	6,143,000

* The numbers credited to these hatcheries are

FRY IN IRELAND, 1905–6 AND 1906–7.

Foreign Salmon.		White Trout.		Brown Trout.		Remarks.
1905-6.	1906-7.	1905-6.	1906-7.	1905-6.	1906-7.	
—	—	—	—	—	1,000	Yearlings from Inishannon.
—	—	—	—	6,000	—	
—	—	—	—	5,000	—	
—	—	—	—	—	—	
—	—	—	—	—	—	
—	—	—	—	—	—	
—	—	—	—	—	—	
—	—	—	—	4,000	—	
—	—	—	—	150,000(a)	115,000(b)	(a) 50,000 Lochlevens. (b) 30,000 Lochlevens, (c) 7,000 from Rockmills, (d) From Weser.
35,000(d)	35,000(d)	—	—	—	—	
—	—	—	—	—	30,000(c)	(c) Lochlevens.
80,000(d)	—	—	—	—	—	(d) From Weser.
—	—	—	—	12,000	—	
—	—	—	—	—	—	
35,000(d)	35,000(d)	—	—	—	—	(d) From Weser.
—	—	—	—	100,000(f)	100,000(f)	(f) 50,000 Lochleven cross.
—	—	—	—	6,000	—	
—	—	—	—	10,000	40,000	From Inishannon.
—	—	340,000	150,000	—	—	
—	—	65,000	100,000	—	—	
—	—	117,000	198,000	—	—	
—	—	—	—	—	—	(g) 27,000 from Rockmills. (d) from Weser.
40,000(d)	40,000(d)	—	—	—	—	
—	—	—	—	—	—	
—	—	—	—	—	—	
—	—	—	—	—	—	
—	—	60,000	60,000	—	300(h)	(h) Lochleven Yearlings from Inishannon.
—	—	—	—	—	—	
—	—	—	—	—	—	
—	—	—	—	78,000(k)	98,000(l)	(k) From Howietoun, and Kilrea, (l) From Howietoun, Itchen, and Kilrea.
—	—	—	—	10,000	—	
190,000	110,000	582,000	508,000	371,000	344,300	

based on estimates made by Officers of the Department.

hatchery work was prolonged by the lowness of the temperature no damage seems to have been caused. Taking the hatcheries or enlarging stations in the order in which they appear on the list, the following remarks may be made:—

The mill reservoir at Brittas is in the hands of a private society and has hitherto been dependent for its supply on annual stocking, since neither affluents nor effluents are available for natural propagation. In the case of private fisheries our functions are, of course, limited to inspection and advice, when demanded. Here it seemed possible, by diversion of waste water during the spawning period, to make a stream in which more or fewer of the impounded fish could spawn in the natural way.

Work at the Lough Dan hatchery has been temporarily abandoned. A considerable number of trout of various ages and origins are being transferred from the rearing ponds to the Lough, whence, on passage next winter to the breeding streams, they will no doubt in some measure achieve the racial crossing for which they were intended. Mr. Archer hopes before long to be able to resume active control of the hatchery, and in the meanwhile the plant and ponds will be kept in good order.

The difficulty of obtaining spawners for the hatchery at Newtownbarry on the Slaney has not yet been overcome. It was thought that works at Clohamon Weir might achieve the desired result, but a survey has shown that while the construction of a trap in the weir would be very costly, its efficiency would be extremely doubtful, and it is to be feared that extensive hatchery operations on the Slaney system are impossible at any place in which a local interest in such work has so far been manifested.

The agreement respecting the establishment of a salmon hatchery at Carlow has been cancelled, owing to difficulties of management.

The hatchery at Inistioge, on the Nore, is mainly dependent for its supply of ova on fish caught in the Arygal tributary by means of a trap, which was considered by the officials of the local Board of Conservators to offer some facilities for poaching. Major Hamilton, at the suggestion of the Department, at once caused the trap and appurtenances to be altered in such a way as to eliminate the possibility of poaching.

Though Mr. Oliver and I, on inspecting the trap after alteration, considered that its efficiency might be improved by some slight structural modification, the poorness of the catch of this season seems to have been due to absence of water, since a fair number of fish were caught during the only two floods with which the Arygal was favoured.

The water supply at the Cahir hatchery, situate on a tributary of the Suir at Ballydavid, has been improved.

A trap at the mouth of the Aherlow river is in process of construction, and the possibility of trapping the main river at Cahir Park is under consideration.

Lismore, perhaps the best equipped hatchery in the United Kingdom, continues to be worked with the most scrupulous care.

The Department's hatchery at Rockmills, on a tributary of the Cork Blackwater, has been considerably improved by the construction, in a part of the old mill-race which forms the hatchery, of stripping pounds and platform, which greatly facilitated spawning operations. The pounds are not yet perfect, since it was found that the longitudinal partitions between the compartments reserved for the two sexes were not sufficiently high to prevent nightly trespass on the part of the males. I was not previously aware that fish would leap obstacles running parallel to the course of the stream, but so they certainly did, and each morning during the stripping season it was necessary to re-sort the occupants left in the pens overnight. It was matter of remark that males, recalcitrant to the enforced performance of their devoir when first driven up to the stripping pens, were much more amenable to discipline after a night spent in proximity to the females, but this observation was not subjected to control experiments and must be taken for what it may be worth.

Rockmills is, so far as I know, the only hatchery at which all the ova are dealt with *ab initio* in floating redds, and it would appear that we have still a good deal to learn before perfection in this method of culture is attained, since the losses, both of ova and fry, seemed unduly great.

In the light of Dr. Hein's paper, published in a previous number of this series (*Fisheries, Ireland, Sci. Invest.*, 1905, *VIII*. [1907]), I thought it advisable to make experiment in the enlarging of fry at a period considerably antecedent to the final disappearance of the yolk, selecting a time at which the alevins manifested a disposition to swim freely about the "redds," as if in search of food. Such transfers from "redds" to natural grounds seemed perfectly successful if conducted with reasonable care, the little fish standing short transport well enough and disappearing as if by magic, when liberated, into the cover afforded by stones and weeds. A most painful experience showed, however, that the proper conduct of transfers of fish of this tender age (about four weeks) cannot safely be entrusted to unskilled hands. The difficulty is that alevins still heavy with yolk have but little power of sustained locomotion, and are therefore liable to suffocation if unduly crowded in a carrying vessel. The losses for which I am responsible arose from my failure to impress upon the hatchery attendants, even by actual demonstration, a sense of the number of fry which might safely be put in each carrying vessel pending my arrival to superintend the enlargement, with the result that I found the vessels stocked with a dense layer consisting, except as to its uppermost elements, of corpses. Others may be more successful in conveying their meaning to unskilled assistants, but I do not recommend the experiment; and unless a hatchery proprietor can command the services of

a trained attendant or is willing to personally supervise all the details of enlargement, it would seem best to leave the fry in the hatching boxes or redds until they are at least five weeks old. I must add that in the columns referring to the Rockmills hatchery I have reduced the totals so as to exclude the losses to which I have just referred.

In regard to the Munster Trout Farm at Innishannon, Mr. Stenning informs us that he was successful in transferring stock without loss to Rathlin Island, an operation which probably covers the longest journey which can be achieved within the limits of Ireland. It appears that the Irish demand for rainbow trout has fallen to a degree at which operations in that species become negligible in their possible effects on the native kinds, and I understand, though from hearsay rather than from exact report, that on the Continent rainbows no longer enjoy the same appreciation as formerly even for strictly commercial culture.

The Department has for some years supplied the little hatchery at Skibbereen with German ova, as being the most readily procurable. This year, at the request of the gentlemen interested, a few thousand Irish ova were also supplied. Mr. O'Shea seems to have, as usual, devoted great care to the hatchery.

Operations, suspended during the previous season owing to a temporary defect in the water supply, were resumed at Caragh Lake on the same scale as in former years.

At Killorglin the proprietors experienced the usual difficulty of getting stud fish in number at reasonable expense by netting in the main river. Negotiations for the construction of traps and holding ponds in tributaries were not carried through on account of the uncertainty of obtaining by this means enough fish to justify the costs of construction and watching, and I may here remark that one of my greatest difficulties in advising the Department as to the establishment of a hatchery arises from want of local knowledge of the run of fish during the close season.

The Department is again indebted to Mr. Finch Hatton for the care which he has devoted to the little hatchery at Ballinruddery on the Cashen.

At Adare the scarcity of salmon in the Maigue and the incidence of floods during the spawning season prevented any operations in salmon culture, but the effect of operations in brown trout is reported to be most satisfactory, the yield of fish having increased in average size as well as in number.

Nothing was done in the way of re-stocking the Suck at Castlerea, because no trout were procurable when required owing to an accident at the hatchery from which they were ordered. The contribution promised by the Department remains available for next season.

Since the first year's work of the Lough Sheelin Association, in regard to both protection and artificial propagation,

was most satisfactory, the Department made for the past season a larger grant in aid of the purchase of ova and also presented the Association with the apparatus necessary for dealing with all the ova laid down, and the output of fry was increased four-fold.

From Costello, where Mr. Laing has conducted the propagation of white trout for many years, it is reported that the past fishing season was the best on record, from which it would appear that the hatchery has done no harm. The fish, however, are said to have shown during the last few years a steady decrease in average size, which is locally attributed to the destruction of slats by the spring mackerel fishing. From another river, where (salmon) hatching operations are carried on extensively, I hear that during the present (1907) season peal are unusually numerous and unusually small, and that both conditions are attributed to the hatchery.

The hatchery at Screebe was subjected to unusual circumstances of temperature. The water froze in the supply pipes, but the ova took no harm. Ova seem, in fact, to be immune from serious damage by low temperature, so long as they themselves escape the mechanical action of actual freezing. The spawners seem to have been larger than usual, reaching 12lbs. and even 20lbs., a fact which may or may not be due to hatching operations in previous years.

The hatchery at Aasleagh was hardly ready for work during the past season, since exceptional floods did great damage during the process of construction.

At Bundrowes the ova were placed in artificial gravel redds within 400 yards of the sea, whither the fry would seem liable to be carried by flood long before they have any business there.

At Newtownstewart and Kilrea the development of the ova and fry was considerably retarded by low temperature, but no damage seems to have ensued. At Kilrea, where the hatching troughs are left uncovered, a species of *Hydra* (a minute fresh-water animal having the general appearance of a "sea-anemone") was found to be abundant on the ova. It appears to be quite harmless to ova and fry of Salmonidae, though dangerous to the tiny fry of such fishes as the roach.

The Conservators of the Coleraine District have for some years taken steps to improve the Lough Neagh trout fishing by the importation of Lochleven ova and fry as well as by artificial propagation of the native trout, in both of which enterprises they have been aided by the proprietors of the Foyle and Bann fisheries, and by contributions from the Department. The arrangement under which the fry were kept in a tributary pending their transfer to the Lough have broken down, and as a temporary expedient the Department have entered into an agreement with Mr. Bernard Meenan and Mr. Hubert Webb for the construction of a pond in which the fry can be held until they are fit to be turned into the Lough. A scheme for the establishment of a a trout farm for the purpose of stocking the Lough is under consideration.

ii.—STATISTICAL INFORMATION RELATING TO THE SALMON FISHERIES.

By the courtesy of the gentlemen whose names appear below, it is possible to give the following Returns in continuation of those which appeared in our Reports for 1900-1905, and in the Report of the Irish Inland Fisheries Commission (Appendix, Part II., xxiii.):—

PERCENTAGES OF TAKE ABOVE AND BELOW AN AVERAGE FOR TWENTY-FIVE YEARS ENDING 1899.

Blackwater, Lismore. Mr. J. GODFREY.

1905, ... 50 per cent. below.
1906, ... 48 ,, ,, ,,

Mr. Godfrey reports that in 1906 the salmon were 55 per cent. and the grilse 66 per cent. below the average of nine years ending 1899. The killing hatch in Lismore Weir was kept open during the months of February, March, and April, as in every year since 1901. The grilse netting was begun about a fortnight later than usual.

Blackwater, Co. Kerry. Mr. R. M'CLURE.

1905, ... 84·7 per cent. below.
1906, ... 74·4 ,, ,, ,,

Waterville, Co. Kerry. Mr. W. J. DELAP.

1905, ... 54·3 per cent. below.
1906, ... 30·1 ,, ,, ,,

Laune, below Killorglin Bridge. Mr. R. POWER.

1905, ... 57 per cent. below the average of the twenty-four years ending 1898.
1906, ... 43 per cent. below do.

Lax Weir (including weir and nets), Shannon. Mr. J. A. PLACE.

1905, ... 25 per cent. below the average of the twenty-three years ending 1899.

Bann Nets. Mr. T. M'DERMOTT.

1905, ... 27 per cent below.

Foyle Nets. Mr. T. M'DERMOTT.

1905, ... 51·5 per cent. below.

Erne Nets. Mr. T. M'Dermott.
1905, ... 34 per cent. below.

Erne Angling. Mr. T. M'Dermott.
1905, ... 22 per cent. below.

Moy Tidal. Mr. J. Garvey.
1905, ... 40 per cent. below.
1906, ... 30 per cent. below the average for 20 years.

Mr. Garvey reports that the nets were taken off three weeks before the end of the open season, and considers that the take was seriously reduced by drift-nets outside the river.

Other Returns.

Blackwater,—Dromana Fishery. Mr. Villiers Stuart.

	Salmon.	Peal.	Total.
1905,	270	441	711.
1906,	256	577	833.

Castleconnell Angling. Messrs. John Enright & Son.

—		Salmon. 1st Feb. to 31st May.	Salmon. 1st June to 31st Oct.	Peal. 1st Feb. to 31st May.	Peal. 1st June to 31st Oct.	Total for Season, Salmon.	Total for Season, Peal.	Total.
Worldsend and Erinagh,	1905	17	2	—	9	19	9	28
	1906	18	1	—	2	19	2	21
Newgarden,	1905	20	3	—	61	29	61	90
	1906	52	4	—	48	56	48	104
Summerhill and Castle,	1905	40	7	—	13	47	13	60
	1906	48	2	—	7	50	7	57
Woodlands,	1905	20	2	—	2	22	2	24
	1906	21	5	—	12	26	12	38
Doonass,	1905	37	3	—	18	40	18	58
	1906	40	4	1	30	44	31	75
Hermitage,	1905	26	4	—	30	30	30	60
	1906	25	6	1	22	31	23	64
Landscape,	1905	9	—	—	—	—	—	9*
	1906	no	return					
Prospect,	1905	26	7	—	32	33	32	66
	1906	29	4	—	39	33	39	72

* To 31st May only.

Suir.—Cahir Park and Neddin's Water. Mr. W. Rochford.

Cahir Park—1905, 49 salmon, weighing 666½ lbs.
1906, 47 ,, ,, 555 ,,

Neddin's Water—1905, 24 ,, ,, 384 ,,
1906, 18 ,, ,, 400 ,,

Waterville Salmon Fishery. Mr. W. J. Delap.

—	Jan. 1st to 15th.	Jan. 16th to 31st.	February.	March.	April.	May.	June.	July.	Total.
1905,	23	26	23	41	22	14	12	18	287
1906,	31		34	42	7	30	179	116	439

RETURN OF IRISH SALMON FROM BILLINGSGATE.

Mr. J. Wrench Towse.

—	Number of Boxes of Irish Salmon.		Average Price per lb.		Number of Boxes from all sources.*	
	1905.	1906.	1905.	1906.	1905.	1906.
			s. d.	s. d.		
January,	37	25	4 0	3 10½	82	132
February,	432	344	2 1	2 3¼	990	725
March,	483	686	2 5½	2 2¾	1,481	1,644
April,	787	646	2 3	2 1¼	1,911	1,814
May,	1,114	667	1 6½	1 11½	3,665	2,527
June,	2,267	2,460	1 4	1 6	6,803	6,851
July,	800	2,126	1 2¼	1 2¾	7,152	7,392
August,	69	146	1 4	1 4	2,745	3,051
September,	—	1	—	—	567	753
October,	—	—	—	—	48	39
November,	—	—	—	—	59	55
December,	—	—	—	—	93	101
	5,976	7,100	—	—	25,607	24,094

* Including English, Scotch, Irish, Dutch, Norwegian, French, Danish, and Canadian.

iii.—SUBSTANCE OF REPORTS RECEIVED FROM CLERKS OF CONSERVATORS RELATIVE TO SALMON FISHERIES.

SUBSTANCE OF REPORTS RECEIVED FROM CLERKS

District.	What is the general state of the Salmon Fisheries in this District? Are they as a rule improving or declining? 1905.	1906.
Dublin, ...	No improvement, ...	About the same as last year; a slight improvement at Ringsend.
Wexford, ...	Declining, ...	Declining, ...
Waterford, ..	Satisfactory, ...	Good; not declining, ...
Lismore, ...	Improving, ...	Good; improving, ...
Cork, ...	Fairly good. About the same as last year,	Fairly good; slight improvement, ..
Cork (Bandon ..	Fair. Improving, ...	Fair; showing tendency to improve, ..
Skibbereen, ..	Declining, ...	Improving, ...
Bantry, ...	Bad. Declining.	Bad; declining, ...
Kenmare, ...	Very bad; declining, ...	Declining for some years; but slight improvement this year.
Waterville, ..	Only fair; if anything, declining, ..	Good; improving very much, ..
Killarney, ..	Poor; not improving, ...	Poor; not improving, ...
Limerick, ..	On the whole not up to average, ..	Past season on the whole up to average,
Galway, .. .	Not at all good; slight improvement on last year.	Not good; slight improvement in some places.
Connemara, ..	Fair all round; improving a little, ..	Fair; improving, ...
Ballinakill, ..	Bad; slightly better than last year, ..	Fair; an improvement on last year, ..
Bangor, ...	Very bad; declining, ...	Unsatisfactory; better than in 1905, but far below the average.
Ballina, ...	Very bad; declining, ...	Fair, ...
Sligo, ...	Fairly good; slight improvement, ..	Improving, ...
Ballyshannon, ..	A good deal better than last year; as a rule improved.	It is believed to have been better than in 1905.
Letterkenny, ..	Prospect very fair; an apparent change for the better in some rivers.	Improving, ...
Londonderry, ..	Not good; declining, ...	Rather better than in 1905, ...
Coleraine, ...	Declining, ...	Improving, ...
Ballycastle, ..	As a rule on the decline, ...	A slight improvement on last season, ..
Dundalk, ...	Satisfactory generally; improving ..	Not so good as last year, ...
Drogheda, ...	Declining, ...	Declining, ...

OF CONSERVATORS RELATIVE TO SALMON FISHERIES.

Has the take of Salmon and Grilse by nets and weirs throughout the district been more or less productive in the present year than in the past one? 1905.	1906.	DISTRICT.
Less, ...	More productive by nets at Ringsend, ..	Dublin.
Less by nets, ...	Less salmon; more grilse, ...	Wexford.
Salmon—more as regards nets; Grilse—less as run did not occur before end of open season.	The take of Salmon by nets and weirs was as good as in previous year; the take of Grilse was very small, as no good run took place before the net season closed.	Waterford.
Take of Salmon good; take of Grilse very poor.	More productive, ...	Lismore.
Less, ...	More productive, ...	Cork.
Salmon, more; Grilse, less, ...	More productive, ...	Cork (Bandon).
Less, ...	A great deal more productive, ..	Skibbereen.
Less, ...	Less productive, ...	Bantry.
Less, ...	Slightly more productive, ...	Kenmare.
Less, ...	More productive, ...	Waterville.
Less, ...	Slightly more productive, ...	Killarney.
Salmon—more; Grilse, season very unsatisfactory, but on the whole better than last year.	Take of Salmon fair; Peal season unsatisfactory.	Limerick.
Slightly more.	Slightly more productive in some places, and less productive in others.	Galway.
—	—	Connemara.
A little more, ...	A good deal more productive, ..	Ballinakill.
Very much less, ...	More productive, ...	Bangor.
About the same, ...	More productive, ...	Ballina.
Slightly on the increase, ...	Take of Salmon about the same; that of Grilse more productive.	Sligo.
More, ...	More productive, ...	Ballyshannon.
Less, ...	No apparent change, ...	Letterkenny.
Less, ...	More productive, ...	Londonderry
Less, ...	More productive, ...	Coleraine.
Very changeable. Some better than last year, some not so good.	Slightly more productive, ...	Ballycastle.
More in Dee and Glyde. Less in Castletown River.	Less productive, ...	Dundalk.
Less, ...	Less productive, ...	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	Has the take of Sea Trout by nets and weirs been more, or less, productive this year than in the past one? 1905.	1906.
Dublin, ...	Less, ...	More productive at Wicklow and Bray,
Wexford, ...	Less by nets, ...	About the same, ...
Waterford, ..	No record of take of Sea Trout, ..	Little or no Sea Trout taken, ...
Lismore, ...	Very poor, and a small class of fish, ..	Good take by weirs; very poor take by nets.
Cork, ...	None taken in this District, ...	Considerably less productive, ...
Cork (Bandon), ..	None taken, ...	None taken in nets or weirs, ...
Skibbereen, ..	Less, ...	More productive, ...
Bantry, ...	Less, ...	Less productive, ...
Kenmare, ...	No netting for Sea Trout in this District,	No nets for Sea Trout used in this district,
Waterville, ..	About the same, ...	More productive, ...
Killarney, ..	No nets or weirs for capture of Sea Trout in District.	About the same, ...
Limerick, ...	None taken in Shannon, ...	No commercial fishing for Sea Trout in Shannon.
Galway, ...	More, ...	Less productive, ...
Connemara, ..	—	—
Ballinakill, ..	More, ...	More productive, ...
Bangor, ...	Less, ...	More productive on Owenmore and Owenduff rivers; less productive on Newport river and Furnace Lough.
Ballina	Same as last year, ...	Less productive, ...
Sligo, ...	Much more. Owing to low water in July and August fish could not get to fresh water.	Much the same, ...
Ballyshannon, ..	A good deal more, ...	Not so good, ...
Letterkenny, ..	No apparent change, ...	About the same, ...
Londonderry, ..	No change, ...	Less productive, ...
Coleraine, ...	About the same, ...	No perceptible difference, ...
Ballycastle, ..	Very few taken, ...	Very few caught in district, ...
Dundalk, ...	Less generally, ...	Less productive, ...
Drogheda, ..	Less, ...	Less productive, ...

of CONSERVATORS relative to SALMON FISHERIES—*continued*.

Has any peculiarity been observed in the date which fish have appeared in the rivers this season? 1905.	1906.	DISTRICT.
—	No, ...	Dublin.
—	Yes. Salmon ran earlier.	Wexford.
No, ...	No, ...	Waterford.
No, ...	No, ...	Lismore.
No, ...	No, ...	Cork.
No, ...	No, ...	Cork (Bandon).
Numerous fish in September, ...	Salmon and Trout numerous early in September.	Skibbereen.
No, ...	No, ...	Bantry.
No, ...	No, ...	Kenmare.
Sea Trout appeared rather earlier than usual.	Sea Trout and Peal appeared earlier than usual.	Waterville.
No.	No, ...	Killarney.
Peal fishing began well and early, but completely collapsed by June 20th—a month earlier than usual.	No, ...	Limerick.
No.	—	Galway.
No, ...	No, ...	Connemara.
No, ...	No, ...	Ballinakill.
No, ...	No, ...	Bangor.
First run of Grilse good, but fishing fell off hopelessly afterwards.	No, ...	Ballina.
No, ...	Grilse appeared about a week earlier than usual.	Sligo.
Yes. A little earlier, ...	Yes. A little later, ...	Ballyshannon.
No, ...	No, ...	Letterkenny.
Run of breeding fish later than usual, ..	No, ...	Londonderry.
No, ...	No, ...	Coleraine.
No, ...	No, ...	Ballycastle.
No, ...	No, ...	Dundalk.
Later than in previous season, ..	Later than in previous season. ..	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	Between what dates did the principal migration of Smolts take place? Was it larger or smaller than usual?	
	1905.	1906.
Dublin, ..	April 28 and June 20. Smaller, ..	During May. Larger, ...
Wexford, ...	April and May. Average, ...	April, May, and June. Larger, ..
Waterford, ..	March, April, and May. Larger, ..	End of March to May. Larger, ..
Lismore, ...	Middle of March to May. Larger, ..	April 1 to 30. Larger, ...
Cork, ...	March 17 to April 12. Average, ..	March 4 to 10. Larger, ...
Cork (Bandon), ..	April 12 to May 10. Larger, ...	April 8 to May 10. About average, ..
Skibbereen, ..	About May 1. Smaller, ...	About middle of May. Larger, ..
Bantry, ...	April and May. Smaller, ...	April and May. Larger, ...
Kenmare, ..	March and April. Cannot say, ..	March and April. Cannot say, ..
Waterville, ..	April 15 to May 15. Larger, ...	April 15 to May 15. Very much larger,
Killarney, ..	March, April, and May. About same, ..	March to May, ...
Limerick, ...	April 15 to May 15. Probably larger, ..	April 15 to May 15. About average, ..
Galway, ...	April and May. Much larger, ..	April and May. Larger, ...
Connemara, ..	April and May. About the same, ..	April and May. No definite change observed.
Ballinakill, ..	Cannot say, ...	Cannot say, ...
Bangor, ...	April 20 to June 20. Up to average, ..	April 15 to May 15. About average, ..
Ballina, ..	April and May. Smaller, ...	April and May. Larger, ...
Sligo, ...	May 7 to 28. Immense quantities, ..	March 20 to June 1. Much larger, ..
Ballyshannon, ..	Middle of April to end of May. About the same.	Middle of April to end of May. About the same.
Letterkenny, ..	Cannot say, ...	Cannot say, ...
Londonderry, ..	April 1 to middle of June. About the same.	April 1 to middle of June. About the same.
Coleraine, ...	April 1 to July 1. Much larger, ..	April 12 to end of June. Somewhat larger,
Ballycastle, ..	End of May and beginning of June. About the same.	End of May and beginning of June. About average.
Dundalk, ...	April and May. Larger in Dee and Glyde. No change observed in other rivers.	April 1 and May 1. No change observed,
Drogheda, ..	April and May. About the same, ..	April and May. About the same, ..

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

Has there been observed more than one migration of Smolts to the sea during the season? If so, state dates when these migrations took place.		DISTRICT.
1905.	1906.	
No, ...	Yes. July 12 to 13, ...	Dublin.
One more, ...	Yes. In August, ...	Wexford.
Yes. On the Suir in June, ..	Yes. On the Suir in June, ...	Waterford.
No, ...	No, ...	Lismore.
No, ...	Yes. March 4 and 10, ...	Cork.
No, ...	No, ...	Cork (Bandon).
No, ...	Yes. June 1, ...	Skibbereen.
No, ...	No, ...	Bantry.
No, ...	No, ...	Kenmare.
No, ...	No, ...	Waterville.
No, ...	No, ...	Killarney.
Yes. There is an Autumn run, ..	Yes. There is always an Autumn run,	Limerick.
Yes. Small migration in September and October.	Yes. Small migration in September and October.	Galway.
No, ...	No, ...	Connemara.
—	—	Ballinakill.
Yes; April 20, May 12, and June 20, ..	Yes. In middle of April and June in Rivers Owenmore and Owenduff.	Bangor.
—	—	Ballina.
Yes; May and end of September. Very few in latter month.	Yes. During June, ...	Sligo.
No, ...	No, ...	Ballyshannon.
No, ...	No, ...	Letterkenny.
Several migrations observed in the Summer—dates not recorded.	Several migrations, but dates were not recorded.	Londonderry.
Several migrations, the principal was that in the last week of April.	Yes. There was a migration after each fresh in the Bann.	Coleraine.
No, ...	No, ...	Ballycastle.
No, ...	No, ...	Dundalk.
No, ...	No	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	In your opinion was the weather favourable or (1). To Netting. 1905.	1906.
Dublin, ...	Favourable, ...	Favourable, ...
Wexford, ...	Favourable, ...	Favourable in April, May, and June; unfavourable in July and August.
Waterford, ..	Generally favourable. Unfavourable to drift nets in estuary owing to fine weather.	Generally favourable, ...
Lismore, ...	Favourable; February to May, ..	Favourable, ...
Cork, ...	Favourable on the whole, ...	Rather favourable in March and April,
Cork (Bandon), ..	Favourable, ...	Favourable, ...
Skibbereen, ..	Favourable, ...	Favourable, ...
Bantry, ...	Favourable, ...	Favourable, ...
Kenmare, ...	Favourable, ...	Unfavourable, ...
Waterville, ..	Favourable, ...	Favourable, ...
Killarney, ...	Favourable, ...	Favourable, ...
Limerick, . ..	Favourable, ...	Favourable in spring; unfavourable in summer owing to floods.
Galway, ...	Generally favourable, ...	Generally favourable, ...
Connemara, ..	Unfavourable, ...	Unfavourable, ...
Ballinakill, ..	Favourable, ...	Favourable, ...
Bangor, ...	Unfavourable up to July; favourable from that to end of season. ..	Favourable, ...
Ballina, ...	Unfavourable, ...	Favourable, ...
Sligo, ...	Fairly favourable, ...	Unfavourable in spring; favourable in summer.
Ballyshannon, ...	Favourable, ...	Favourable, ...
Letterkenny, ..	Very favourable, ...	Favourable during parts of the season; most unfavourable during others.
Londonderry, ..	Unfavourable, ...	Nothing unusual, ...
Coleraine, ...	Unfavourable, ...	Favourable in tidal waters; unfavourable in upper waters.
Ballycastle, ..	Unfavourable, ...	At times very unfavourable, ...
Dundalk, ...	Favourable during early part of season, but unfavourable towards the end.	Favourable, ...
Drogheda, ..	Favourable, ...	Favourable, ...

of Conservators relative to Salmon Fisheries—*continued*.

unfavourable in each month of the open season? (II). To Angling. 1905.	1906.	District.
Unfavourable, ...	Unfavourable, ...	Dublin.
Unfavourable, ...	Favourable in February, March, and April; unfavourable from May to August.	Wexford.
Unfavourable, except in the Spring, ..	Favourable during early part; unfavourable afterwards.	Waterford.
Favourable, February to May; Unfavourable, June to September.	Favourable up to 12th May; unfavourable afterwards.	Lismore.
Favourable on the whole, ...	Only middling, ...	Cork.
Favourable to May—then unfavourable.	Favourable, except April, June, and July, which were very unfavourable.	Cork (Bandon).
Unfavourable, ...	Favourable, ...	Skibbereen.
Unfavourable, ...	Favourable, ...	Bantry.
Favourable, ...	Favourable, except September, ..	Kenmare.
Favourable, ...	Favourable, ...	Waterville.
Favourable, ...	Unfavourable, ...	Killarney.
Favourable in Spring, ...	Favourable, ...	Limerick.
Favourable, March to June. Unfavourable, July and August.	Generally favourable, ...	Galway.
Favourable, ...	Favourable, ...	Connemara.
Unfavourable, ...	Favourable, ...	Ballinakill.
Unfavourable up to July; favourable from that on to end of season.	Favourable, ...	Bangor.
Unfavourable, ...	Favourable, ...	Ballina.
Unfavourable, ...	Fairly good all round, ...	Sligo.
Unfavourable, ...	Not so favourable as for netting, ..	Ballyshannon.
Favourable, ...	Favourable during parts of the season; most unfavourable during others.	Letterkenny.
Unfavourable, ...	Nothing unusual, ...	Londonderry.
Favourable to end of June; from that on unfavourable.	Most unfavourable up to June; but favourable balance of season.	Coleraine.
Unfavourable up to April, then fair and subsequently very favourable.	Favourable as a rule, ...	Ballycastle.
Favourable during early part of season, unfavourable towards the end.	Favourable, ...	Dundalk.
Favourable, ...	Favourable, ...	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	At what period of the year is Grilse first taken?	
	1905.	1906.
Dublin, ...	July, ...	End of June, ...
Wexford, ...	June, ...	From middle of June to August 1, ..
Waterford, ..	May, ...	May and June, ...
Lismore, ...	April 19, ...	May 3, ...
Cork	May, ...	April, ...
Cork (Bandon), ..	First week in June, ...	Last week in May, ...
Skibbereen, ..	—	August, ...
Bantry, ...	July, ...	July, ...
Kenmare, ...	June, ...	June, ...
Waterville, ..	July 5, ...	June 25, ...
Killarney, ..	End of May, ...	About middle of May, ...
Limerick, ...	End of May, ...	End of May, ...
Galway, ...	June, ...	May 7, ...
Connemara, ..	June, ...	June, ...
Ballinakill, ..	First week in June, ...	Last week in June, ...
Bangor, ...	May, ...	May, ...
Ballina, ...	May, ...	May, ...
Sligo, ...	About May 30, ...	In Ballysodare Division, May. In Sligo Division April 15.
Ballyshannon, ..	End of June, ...	June, ...
Letterkenny, ..	June to August, ...	About June 5, ...
Londonderry, ..	May 23, ...	May 28, ...
Coleraine, ..	Last week of May, ...	June, ...
Ballycastle, ..	Latter end of May, ...	Beginning of May, ...
Dundalk, ...	July, ...	July, ...
Drogheda, ..	June, ...	June, ...

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

During what months is the greatest quantity observed or taken? 1905.	1906.	DISTRICT.
July, ...	July, ...	Dublin.
June, ...	—	Wexford.
May, ...	July and August, ...	Waterford.
April 19, ...	June and July, ...	Lismore.
May, ...	April and June. Only small quantity taken.	Cork.
First week in June, ...	June, ...	Cork (Bandon).
—	—	Skibbereen.
July, ...	July, ...	Bantry.
June, ...	July, ...	Kenmare.
July 5, ...	First two weeks in July, ...	Waterville.
End of May, ...	June, ...	Killarney.
End of May, ...	June, ...	Limerick.
June, ...	June, ...	Galway.
June, ...	June and July, ...	Connemara.
First week in June, ...	End of June and first week in July, ..	Ballinakill.
May, ...	June and July, ...	Bangor.
May, ...	July, ...	Ballina.
About May 30, ...	July	Sligo.
End of June, ...	Half of June and beginning of July, ..	Ballyshannon.
June to August, ...	August, ...	Letterkenny.
May 23, ...	July, ...	Londonderry.
Last week of May, ...	July, ...	Coleraine.
Latter end of May, ...	Last week in June, and first two weeks in July.	Ballycastle.
July, ...	August, ...	Dundalk.
June, ...	July, ...	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	During what months are many Salmon taken with the Grilse, and are these Salmon on an average heavier or lighter than at other periods? 1905.	1906.
Dublin, ...	July. Heavier, ...	June, July, ...
Wexford, ...	June, July, August. Heavier, ..	September. Heavier, ...
Waterford ..	July and August. Generally lighter, ..	July and August. Lighter, ...
Lismore, ...	May and June, ...	Middle of May to July 12. Heavier, ..
Cork, ...	June and July. About average size, ..	July. Same average weight, but not many taken.
Cork (Bandon), ..	Early in July. Heavier, ...	June. Somewhat heavier, ...
Skibbereen, ..	August. Lighter, ...	August. Heavier, ...
Bantry, ...	June. Lighter.	June. Heavier, ...
Kenmare, ...	June and July, ...	June and July. Heavier, ...
Waterville, ..	August and September. Rather lighter,	July and August. Rather lighter, ..
Killarney, ...	End of May and beginning of June. On an average heavier.	End of May and beginning of June. Heavier.
Limerick, ...	May. Lighter, ...	May. Lighter, ...
Galway, ...	June and July, ...	June and July. Lighter, ...
Connemara, ..	July and August. About the same as in other months.	July and August. About the same as in other months.
Ballinakill, ..	First week in June. Somewhat heavier,	End of June. Lighter, ...
Bangor, ...	May and June. About the same, ..	June. Heavier, but very few taken, ..
Ballina, ...	June and July. Average, ...	June. No, ...
Sligo, ...	June, July, and early in August. Heavier,	April and May. Heavier, ...
Ballyshannon, ..	From June on, ...	July, ...
Letterkenny, ..	June and July. Heavier, ...	June 15 to July 15. Much heavier, ..
Londonderry, ..	June, July, and August, ...	June, July, and August, ...
Coleraine, ...	July. Weight about same as in other months.	July and August. About the same as in other months
Ballycastle, ..	Heavy Salmon ran in April and towards the end of the season.	Heavy Salmon ran in the beginning of the season, and a still heavier class run at the very end of the season.
Dundalk, ...	July and August. Lighter, ...	July and August. Lighter, ...
Drogheda. ..	July. Lighter, ...	July. Lighter, ...

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

In what months are the greatest quantities of Salmon (not Grilse) taken?		DISTRICT.
1905.	1906.	
June, ...	May 15 to June 15, ...	Dublin.
May, ...	April and May, ...	Wexford.
February to May, ...	March, April, and May, ...	Waterford.
February, March, and April, ...	February to May 12, ...	Lismore.
February, March, and April, ...	March and April, ...	Cork.
March and April, ...	March and April, ...	Cork (Bandon).
August and September, ...	August and September, ...	Skibbereen.
June, ...	June, ...	Bantry.
July, ...	July, ...	Kenmare.
February, March, and April, ..	February, March, and April, ...	Waterville.
February, March, and April, ..	February, March, and April, ...	Killarney.
April and May, ...	April and May, ...	Limerick.
March, April, and May, ...	March, April, and May, ...	Galway.
July to October, ...	July to October, ...	Connemara.
May, ...	June, ...	Ballinakill.
April and May, ...	April and May, ...	Bangor.
May and June, ...	During the spring months, ...	Ballina.
January to March, Sligo Division. June in Ballysodare Division.	January to March, Sligo Division. April and May in Ballysodare Division	Sligo.
May, ...	May, ...	Ballyshannon.
July and August, ...	July and August, ...	Letterkenny.
July and August, ...	July and August, ...	Londonderry.
May and June, ...	July and August, ...	Coleraine.
From beginning of season to May 1, and from middle of July to end of season.	From beginning of season to first week in May, and from the middle of July to end of season.	Ballycastle.
March, April, and May, ...	March, April, and May, ...	Dundalk.
April and May, ...	April and May, ...	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	Can it be ascertained what proportion the capture of Grilse bears to the capture of Salmon? 1905.	1906.
Dublin, ..	About 8 to 1.	About 3 to 1
Wexford, ..	About 1 to 3,	About 1 to 3,
Waterford,	About 1 to 10.	A very small proportion,
Lismore, ..	No,	No,
Cork,	No. But more Salmon are taken,	No. But more Salmon are taken,
Cork (Bandon),	No,	About 1 to 4,
Skibbereen,	No,	2 to 1,
Bantry, ..	15 to 1,	20 to 1,
Kenmare, ..	10 to 1.	9 to 1,
Waterville,	1 to 3,	1 to 4,
Killarney, ..	2 to 1,	2 to 1,
Limerick, ..	5 to 1,	5 to 1,
Galway, ..	5 to 1.	9 to 2,
Connemara,	Equal on Ballinahinch and Screebe; 1 to 3 on other fisheries.	Equal on Ballinahinch and Screebe; 1 to 3 on other fisheries.
Ballinakill,	6 to 1,	8 to 1,
Bangor, ..	4 to 1.	6 to 1,
Ballina, ..	No, but best Grilse more numerous than Salmon.	No,
Sligo,	Sligo, 3 to 1; Ballysodare, 4 to 1,	No. But Salmon more numerous than Grilse.
Ballyshannon,	Erne, 1 to 2; other rivers Grilse more numerous than Salmon.	5 to 3.
Letterkenny,	5 to 1,	6 to 1,
Londonderry,	The majority of fish taken are Grilse,	No. But the majority of fish taken are Grilse.
Coleraine, ..	2 to 1,	Sea fisheries, 180 to 1. Inland, 10 to 1.
Ballycastle,	Not ascertained,	Not ascertained,
Dundalk, ..	No,	No,
Drogheda,	Salmon far exceed Grilse in numbers,	More Salmon than Grilse are taken,

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

Is there any increase in the average size of Spring Salmon or Grilse? Give average weight of Salmon and Grilse in the season of this year, as far as practicable. 1905.	1900.	DISTRICT.
Spring Salmon, 11 lbs.; Grilse, 4 lbs., ..	Spring Salmon, 11 lbs.; Grilse, 5 lbs., ..	Dublin.
Spring Salmon, smaller; salmon, 12 lbs.; Grilse, 0 lbs.	Salmon, 12 lbs.; Grilse, 5 to 8 lbs., ..	Wexford.
No general increase, but some large fish up to 46 lbs. taken. Salmon, 12 to 14 lbs.; Grilse, 4 to 6 lbs.	Average size maintained. Salmon, 12 to 15 lbs.; Grilse, 3 to 6 lbs.	Waterford.
Salmon, 10 to 17 lbs.; Grilse, 5 to 7 lbs.,	Yes, in Salmon. Salmon, 7 to 40 lbs.; Grilse, 3 to 7 lbs.	Lismore.
Yes. Salmon, 10 lbs.; Grilse, 3 lbs., ..	Salmon, 9 lbs.; Grilse, 3 lbs., ..	Cork.
Yes, in Salmon, but not in Grilse. Salmon 16 lbs.; Grilse, 5 lbs.	Yes. Salmon, 15 lbs.; Grilse, 0 lbs., ..	Cork (Bandon).
No. Salmon, 8 lbs., ...	Salmon, 8 lbs.; Grilse, 3 lbs.	Skibbereen.
Salmon, 12 lbs.; Grilse, 5 lbs., ..	Salmon, 15 lbs.; Grilse, 5 lbs., ..	Bantry.
Salmon, 10 lbs.; Grilse, 5 lbs., ..	No. Salmon, 10 lbs.; Grilse, 5 lbs., ..	Kenmare.
No. Salmon, 11 lbs.; Grilse, 5 lbs., ..	Salmon, 12 lbs.; Grilse, 5 lbs., ..	Waterville.
No. Salmon, 11 lbs.; Grilse, 5 lbs., ..	No. Salmon, 11 lbs.; Grilse, 5 lbs., ..	Killarney.
Slight improvement in Salmon and Grilse. Salmon, 16½ lbs.; Grilse, 5½ lbs.	Size about average. Salmon, 16½ lbs.; Grilse, 5 lbs.	Limerick.
Slight improvement n Salmon. Salmon, 14½ lbs.; Grilse, 6 lbs.	Salmon, 13½ lbs.; Grilse, 0½ lbs., ..	Galway.
No. Salmon, 10 lbs.; Grilse, 7 lbs. ..	Salmon, 9½ lbs.; Grilse, 7 lbs., ..	Connemara.
Salmon, 12½ lbs.; Grilse, 6 lbs., ..	Salmon, 11 lbs.; Grilse, 6½ lbs., ..	Ballinakill.
Slight increase. Salmon, 9 lbs; Grilse, 5½ lbs.	Salmon, 0 lbs.; Grilse, 5½ lbs., ..	Bangor.
No. Salmon, 10½ lbs.; Grilse, 6 lbs., ..	Salmon, 10½ lbs.; Grilse, 0½ lbs., ..	Ballina.
Salmon, 6 to 18 or 20 lbs.; Grilse, 2 to 6 lbs.	Salmon, 10 lbs.; Grilse, 6½ lbs., ..	Sligo.
No. Salmon, 16 lbs.; Grilse, 6 lbs., ..	Salmon, 16 lbs.; Grilse, 5½ lbs., ..	Ballyshannon.
Slightly on the increase, ...	In general size of Salmon is increasing yearly. Grilse, 6, to 7 lbs., ...	Letterkenny.
No. Salmon, 10 lbs.; Grilse, 6½ lbs., ..	No. Salmon, 10 lbs.; Grilse, 6½ lbs., ..	Londonderry.
No. Salmon, 10 lbs.; Grilse, 6 lbs., ..	Salmon, 12 lbs.; Grilse, 6 lbs., ..	Coleraine.
Probably none. Salmon, 9 to 18 lbs.; Grilse, 4½ to 7 lbs.	Probably none. Salmon, 0 to 20 lbs.; Grilse, 4½ to 7 lbs.	Ballycastle.
No. Salmon, 14 lbs.; Grilse 8 lbs., ..	Salmon, 14 lbs.; Grilse, 5 lbs., ..	Dundalk.
Salmon, 15 lbs.; Grilse, 5 lbs., ..	No. Salmon, 15 lbs.; Grilse, 5 lbs., ..	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	Has any sign of disease been observed among the Salmon during the year? If so, describe it, and state if it has prevailed to any extent, and where? 1905.	1906.
Dublin, ..	No, ...	No, ...
Wexford, ..	No, ...	No, ...
Waterford,	Yes, on the Barrow at Carlow, during January, when the Salmon were numerous, at the weir. The disease was diagnosed as Saprolegnia.	No, ...
Lismore, ..	No, ...	No, ...
Cork ..	No.	No, ...
Cork (Bandon),	No, ...	No, ...
Skibbereen,	No, ...	No, ...
Bantry, ..	No, ...	No, ...
Kenmare ..	No, ...	No, ...
Waterville,	No, ...	No, ...
Killarney,	No, ...	No, ...
Limerick, ..	No, ...	No, ...
Galway, ..	No, ...	No, ...
Connemara,	No, ...	No, ...
Ballinakill,	No, ...	No, ...
Bangor ..	No, ...	No, ...
Ballina, ..	No, ...	No, ...
Sligo, ..	Yes, a few diseased fish, ...	No, ...
Ballyshannon,	No, ...	No, ...
Letterkenny,	No, ...	No, ...
Londonderry,	No, ...	No, ...
Coleraine,	No, ...	No, ...
Ballycastle,	No, ...	No, ...
Dundalk, ..	No, ...	No, ...
Drogheda,	No, ...	No, ...

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

Can you give any information about the run of Salmon and Grilse in each mouth of the close season? 1905.	1906.	DISTRICT.
No, ...	No, ...	Dublin.
Salmon and Grilse run in the Slaney, &c., during November, December, and January.	Good runs of Salmon from October to January.	Wexford.
Owing to exceptionally dry winter very few Salmon ran.	Principal run under favourable conditions is in November and December.	Waterford.
From October 1 to November 20 there was a large run of both Salmon and Grilse. The number of spawning fish in the Blackwater was above the average.	A continuous run of Salmon and Grilse from October 1 to November 30.	Lismore.
No.	A run from end of October to about December 20.	Cork.
No, ...	Salmon run in end of October and November. No run of Grilse during close season.	Cork (Bandon).
No.	No, ...	Skibbereen.
No, ...	No, ...	Bantry.
No, ...	No, ...	Kenmare.
Spring Salmon commenced to run into Lough Currane in November.	Spring Salmon commenced to run in November. An exceptionally good run in January.	Waterville.
The run of Salmon and Grilse from August to November was poor; up to Christmas, fair; after Christmas, poor.	The run of Salmon and Grilse from August to November was poor. A good run in December up to about 27th; but scarcely any seen after that date.	Killarney.
Entirely depends upon the weather, ..	Entirely depends on the weather, ..	Limerick.
Practically no run in the close season, until the Spring fish begin to run early in the year.	Except an occasional spring fish, there is practically no run during the close season.	Galway.
No, ...	No, ...	Connemara.
No, ...	No, ...	Ballinakill.
No, ...	No, ...	Bangor.
No, ...	No, ...	Ballina.
Salmon run in November and December.	In Ballysodare fishery a good run of Salmon and Grilse in September and October. In Sligo fishery a fair run in November, and a few in December.	Sligo.
No, ...	No, ...	Ballyshannon.
No, ...	No, ...	Letterkenny.
The principal run in the Foyle was in December; included many bright, clean fish as if fresh from the sea.	The heaviest runs are in October and November.	Londonderry.
A heavy run of fish in the Bann at the end of August, and again in October.	A good run of Salmon in the Bann on August 25 and 20, another in October, and with every flood up to November 24 a fresh run of fish.	Coleraine.
No, ...	No, ...	Ballycastle.
Salmon ran in November and December,	Heavy runs of Salmon in November and December and much more Grilse than usual in November.	Dundalk.
No, ...	No, ...	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	Have there been any cases of poisoning the rivers in the District? If so, give particulars of the different cases, and if by Lime, Spurge, or Flax Water. 1905.	1906.
Dublin, ...	One alleged case at Island Bridge, River Liffey, by discharge of creosote.	One case in River Liffey at Island Bridge,
Wexford, ...	No, ...	No, ...
Waterford, ..	A few by lime or chloride of lime, ..	None reported, ...
Lismore, ...	No, ...	No, ...
Cork, ...	No, ...	One case by spurge in River Sullane. Four fish killed.
Cork (Bandon), ..	No, ...	No, ...
Skibbereen, ..	Yes, several, ...	One case of the use of dynamite, ..
Bantry, ...	One case in Coomhola River by spurge,	No, ...
Kenmare, ...	Two cases in River Roughty by spurge,	Two cases of poisoning by spurge in River Sheen, and one case in River Slaheny.
Waterville, ..	No, ...	No, ...
Killarney, ..	No, ...	One case of poisoning by lime in the Brown Flesk, and a case of the use of an explosive on River Maine.
Limerick, ...	Three cases—two by lime at Rathkeale, and Abbeyfeale, and one by spurge at Duagh.	Three cases of poisoning by lime reported,
Galway, ...	No proved cases, but there is a deleterious discharge from a factory at Galway.	No legally proved cases, but a factory is said to discharge deleterious matter into the river.
Connemara, ..	No, ...	No, ...
Ballinakill, ..	No, ...	No, ...
Bangor, ...	No, ...	No, ...
Ballina, ...	No, ...	No, ...
Sligo, ...	Alleged case of use of dynamite at Ballysodare.	No, but some fish have been killed by dynamite.
Ballyshannon, ..	No, ...	No, ...
Letterkenny, ..	None, except from flax water, ..	Several cases of flax water poisoning, ..
Londonderry, ..	One case in tributary of Roe by lime; much damage done by flax water owing to dry year.	One case of poisoning by coal gas and tar. Large quantities of fry destroyed by flax water in tributaries.
Coleraine, ...	Two cases in Sixmilewater by chloride of lime; forty-three cases by flax water.	Yes; over one hundred cases of flax water pollution have been reported and prosecutions instituted in most cases.
Ballycastle, ..	A few by flax water, ...	Several cases of flax water pollution in vicinity of Cushendall.
Dundalk, ...	Twenty cases by flax water, ...	Cases of flax water poisoning, but not nearly so much damage done as formerly.
Drogheda, ..	One by flax water, ...	No, ...

of CONSERVATORS relative to SALMON FISHERIES—*continued*.

Has the quantity of Breeding Fish observed in the rivers in your District during this winter been greater or less as compared with last winter?		DISTRICT.
1905.	1906.	
Greater, ...	About the same, ...	Dublin.
Far greater, ...	Greater, ...	Wexford.
Less in tributaries, ...	Greater in the Suir and Barrow, .. About the same in the Nore, ...	Waterford.
Greater, ...	Greater, ...	Lismore.
Greater, ...	About the same, ...	Cork.
About the same, ...	About the same, ...	Cork (Bandon).
Greater, ...	Greater, ...	Skibbereen.
Greater, ...	Less, ...	Bantry.
Greater in some, less in others, ..	Greater, ...	Kenmare.
Greater, ...	Greater, ...	Waterville.
Less, ...	About the same, ...	Killarney.
Greater in the main rivers, ...	Greater on the whole, ...	Limerick.
Less, ...	Slightly less, ...	Galway.
Slightly greater, ...	About the same, ...	Connemara.
Much the same, ...	Greater, ...	Ballinakill.
About the same, ...	Much greater, ...	Bangor.
About the same, ...	Greater, ...	Ballina.
Greater, ...	Owing to height of water it is impossible to say.	Sligo.
Much greater, ...	Greater, ...	Ballyshannon.
No remarkable change, ...	Greater, ...	Letterkenny.
Less, ...	Somewhat greater, ...	Londonderry.
Much greater, ...	About the average, ...	Coleraine.
A little above average, ...	Possibly somewhat greater, ...	Ballycastle.
Somewhat greater, ...	No change noticed, ...	Dundalk.
Greater, ...	Less, ...	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	In what Rivers has the quantity increased? 1905.	1906.
Dublin, ...	Liffey, ...	None, ...
Wexford, ...	Slaney and Boro, ...	Slaney, ...
Waterford, ..	Lower tributaries of the Barrow and the King's River.	Main rivers and some of their tributaries.
Lismore, ...	Main river, ...	Main river and some of its tribulades,
Cork, ...	Lee and Salaune, ...	None, ...
Cork (Bandon), ..	None, ...	None, ...
Skibbereen, ..	Ilen, ...	Ilen, ...
Bantry, ...	All rivers	None, ...
Kenmare, ...	Derreen district and Sneem river, ..	All rivers, ...
Waterville, ..	All rivers, ...	All rivers, ...
Killarney, ..	None, ...	None, ...
Limerick, ...	Main river (part) and Mulkear, ..	Main river and some of its tributaries, especially the Suck, Brosna, and Boyle.
Galway, ...	Tributaries of Clare and Oughterard rivers.	Oughterard and Clare-Galway Rivers, ..
Connemara, ..	Ballinahinch, Inver, Gowla, Screebe, and Costello.	None, ...
Ballinakill, ..	None, ...	All rivers, ...
Bangor, ...	None	All rivers, ...
Ballina, ...	Moy and its main tributaries, ..	The main rivers, ...
Sligo, ...	All rivers, ...	No information on account of floods, ..
Ballyshannon, ..	Erne and tributaries, and Bundrowes, ..	Erne and tributaries and Bundrowes, ..
Letterkenny, ..	Swilly and Clady, ...	All rivers, ...
Londonderry, ..	None, ...	All rivers, ...
Coleraine, ...	All rivers, ...	None, ...
Ballycastle, ..	Ballycastle and Bush, ...	Probably in Bush, ...
Dundalk, ...	All rivers, ...	None, ...
Drogheda, ..	All rivers, ...	None, ...

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

In what Rivers has the quantity decreased ? 1905.	In what Rivers has the quantity decreased ? 1906.	DISTRICT.
Bray, ...	None, ...	Dublin.
Urrin and Blackwater, ...	None, ...	Wexford.
In the higher tributaries generally, ..	Some of the tributaries owing to unfavourable weather.	Waterford.
All the tributaries, ...	Some of the tributaries, viz., Bride, Allow, Clyda, Finisk, and Ross.	Lismore.
None, ...	None, ...	Cork.
None, ...	None, ...	Cork (Bandon).
No information, ...	—	Skibbereen.
None, ...	All rivers, ...	Bantry.
Sheen and Blackwater, ...	None, ...	Kenmare.
None, ...	None, ...	Waterville.
All rivers, ...	None, ...	Killarney.
All tributaries, ...	Camlin, Killimer, and Inny, ...	Limerick.
All other rivers, ...	Abbert, Grange, and some minor rivers,	Galway.
Skannive and Doohulla, ...	None, ...	Connemara.
Culfin and Dawros, ...	None, ...	Ballinakill.
Tributaries of Carrowmore Lake, ..	None, ...	Bangor.
Rathfran, Easky, Pulaheeny, and one tributary of Moy.	Some of the upper tributaries, ..	Ballina.
None, ...	No information on account of floods, ..	Sligo.
None, ...	None, ...	Ballyshannon
None, ...	None, ...	Letterkenny.
All rivers, ...	None, ...	Londonderry
None, ...	None, ...	Coleraine.
None, ...	—	Ballycastle.
None, ...	None, ...	Dundalk.
None	All rivers, ...	Drogheda.

SUBSTANCE OF REPORTS received from CLERKS

DISTRICT.	Was the state of the rivers favourable or unfavourable to spawning, and to the protection of spawning, and spent fish, and young fry? 1905.	1906.
Dublin, ...	Liffey favourable. Bray unfavourable,	Liffey fairly favourable. Bray and Wicklow unfavourable.
Wexford, ...	Slaney Boro, and Bann favourable. Urrin and Blackwater unfavourable.	Favourable in all rivers, ...
Waterford, ..	Generally favourable in main rivers, as fish were prevented from entering dangerous tributaries.	Generally favourable. Owing to low water most spawning took place in the main rivers.
Lismore, ...	Favourable to protection of fish ..	Favourable in all rivers, ...
Cork, ...	Fairly favourable, ...	Lee and Sullane favourable, ...
Cork (Bandon), ..	Early Winter unfavourable to run of spawners—later favourable.	Favourable. Owing to low water most spawning took place in the main rivers.
Skibbereen, ..	Very favourable, ...	Very favourable in the Ilen, ...
Bantry, ...	Favourable to spawning and protection,	Favourable in all rivers, ...
Kenmare, ...	Favourable, ...	Favourable in all rivers, ...
Waterville, ..	Very favourable for spawning, ..	Very favourable in all rivers. A most successful spawning season.
Killarney, ..	Generally favourable, ...	Favourable, ...
Limerick, ...	Unfavourable to spawning; spawners and spent fish fairly well protected.	Favourable for spawning and for protection of fish.
Galway, ...	Generally favourable	Unfavourable during early part of spawning season owing to low water, but improved later.
Connemara, ..	Favourable, ...	Favourable in all rivers, ...
Ballinakill, ..	Very favourable, ...	Very favourable in all rivers, ...
Bangor, .. .	Favourable to all, ...	Favourable in all rivers, ...
Ballina	Very favourable for spawning, ..	Favourable in December, ...
Sligo, ...	Favourable for spawning and spent fish; low water unfavourable for fry.	Favourable, ...
Ballyshannon, ..	Generally favourable, ...	Favourable, ...
Letterkenny, ..	Very favourable in all rivers owing to high water.	Favourable, ...
Londonderry, ..	Favourable, ...	Favourable in early part of spawning season; not so favourable later owing to low water.
Coleraine, ..	Most favourable owing to high water, and mild weather.	Favourable, except in Kells River and Sixmilewater.
Ballycastle, ..	Favourable owing to high water, ..	Very favourable, ...
Dundalk, ...	Favourable in all rivers, ...	Favourable owing to high water, ..
Drogheda, ..	Favourable generally, ...	Favourable, ...

of CONSERVATORS relative to SALMON FISHERIES—*continued.*

Any particular observations? 1905.	1906.	DISTRICT.
—	—	Dublin.
Low water kept spawners out of the smaller rivers.	—	Wexford.
Unusual absence of floods during spawning season.	Spawning was very late, ...	Waterford.
—	—	Lismore.
—	—	Cork.
—	—	Cork (Bandon).
—	—	Skibbereen.
Heavy floods in January destroyed much spawn.	—	Bantry.
—	—	Kenmare.
More breeding fish observed than for past ten years.	—	Waterville.
No run of spawners after Christmas, ..	—	Killarney.
—	—	Limerick.
—	Much damage done by wild ducks to spawn.	Galway.
—	—	Connemara.
—	—	Ballinakill.
The run of fish was late this winter, ..	Owing to excessive number of breeding fish the spawning beds in Owenmore and Owenduff were disturbed several times by successive spawners.	Bangor.
—	—	Ballina.
—	—	Sligo.
Spawning fish were fourteen days earlier,	Spawning fish were fourteen days later,	Ballyshannon.
—	—	Letterkenny.
Run of breeding fish later than usual, ..	—	Londonderry.
Fish larger than usual, and spawned earlier.	—	Coleraine.
A little better than an average year, ..	—	Ballycastle.
—	—	Dundalk.
—	—	Drogheda.

INLAND FISHERIES.

iv.—SUMMARY OF REPORTS RELATIVE TO EEL FRY, 1905 TO 1907,

BY

E. W. L. Holt.

These reports consist of answers received to queries sent out in a form similar to those relating to salmon and eel fisheries. Returns relative to the eel fisheries of their several districts have been furnished to the Fishery Authority for many years by Clerks of Boards of Conservators, but deal chiefly with the commercial aspect of the industry. Since it seemed desirable, in view of possible developments of eel fishing, to obtain a more exact knowledge of the circumstances relating to the ascent of the fry, the list of queries has been enlarged, and the Department now issue two forms, of which one has reference to the commercial fishery, while the other is solely concerned with the fry. A summary of the replies received in response to the first circular will be found in Part I. of the Report on the Sea and Inland Fisheries, while the second will be dealt with, as at present, in Part II. and in the separate series entitled "Scientific Investigations." Both circulars are addressed to Clerks of Conservators, but the fry circular is also sent to anyone whom we suppose to be in a position to give us useful information. Assistance of this sort is especially necessary in districts where no important eel fishery exists, and bailiffs are not called upon to pay much attention to the protection of the fry.

It will be seen from the table that up to the present we have received no information of importance from several districts, while in regard to some others the reports are rather meagre.

In part this was due, in 1906-1907, to heavy floods, which rendered it difficult to observe the ascent of fry.

The annual period covered by the queries was somewhat different in the two years, but not to an important extent. In future the period will be from 1st October to 30th September, as this seems to cover all important movements of fry in both early and late rivers.

The table deals with dates of observation. Information was also invited as to the prevalence of any considerable destruction of fry and the existence of obstacles to their ascent.

In general no obstacles were reported, but Lismore, Limerick Galway, Sligo, and Coleraine are exceptions, as thus:—

Lismore.—Clondulane Weir.

Limerick.—Charleville Waterworks. Serious injury is usually caused here, but was less in 1907 than in former years, as, owing to floods, fry passed up on the north side of the river, and so avoided the waterworks cutting. The rocks at Doonass are also cited as obstacles, and it is suggested that passages should be cleared among them.

Galway.—Millraces at Galway, especially a disused race closed at the head, in which great numbers of fry accumulated in 1906. They were passed over the obstacle in buckets. Canal-locks also offer obstruction, but only of a temporary nature. Minor obstructions are reported from the Spiddal, Owenbolisky, and Oughterard rivers,

Sligo.—Ballysodare Falls and Collooney Mills, where it is reported that fry can hardly get up at all except by the salmon ladders.

Coleraine.—Various obstacles on the Lower Bann, but passes are provided. It is suggested that some of these might be improved.

At a number of places birds are accused of destroying considerable quantities of fry. Among the delinquents are cited cormorants, gulls, tame ducks, and crows. Mr. Milne reports that a cormorant was found to contain 240 fresh fry, about double that number partially digested, and an eel 12 inches long. Efforts to scare cormorants and gulls with blank cartridge proved a failure, as the birds got used to the noise. He suggests the exemption of cormorants and gulls from the benefits of the Wild Birds Protection Acts during the periods of ascent of eel fry and descent of smolts. Trout are also accused of destroying eel fry, especially slob trout.

No considerable destruction of fry by human agency appears to be prevalent, but in the Lismore district a person was fined in 1907 for taking fry, and at Limerick extra protection has to be afforded during the period of ascent.

The Clerk of the Bandon Board mentions that there has been no run of fry in the Bandon river for the last five or six years, though formerly there used to be a regular ascent.

In general it appears that the period which elapses between the appearance of the fry in the tidal parts of rivers and their ascent to the upper reaches is to some extent dependent on the state of the rivers. Thus in the Shannon in 1907 the fry, which usually move up in May, were delayed until July. The opportunity of observing their actual first arrival in the estuaries must depend to a great extent on the height of the river and clearness of water, but it is evident that they may come as early as November.

In addition to the Clerks of Conservators, the acknowledgments of the Department are due, for valuable information, to Mr. Barr, of Aasleagh; Major Bruce, of Toome Bridge; Alderman Henry Dale, of Cork; Mr. Delap, of Cahirciveen; the Misses Delap, of Valencia; and Mr. Swan, of Ballyshannon

DISTRICT.	SEASON.	1. When were Eel Fry first seen in the tidal parts of the rivers in your district? Give names of rivers and dates separately, and names of places where fry were first seen, and, if possible, note whether the Fry were white (i.e., colourless) or black. River.	Place.	Date.	Colour (white or black).
Dublin, ..	1-10-1905 to 30-9-1906	Liffey, ...	Island Bridge, ..	16th May, ..	Black, ..
		Bray, ...	Bray River, ..	10th June, ..	Do., ..
		Dodder, ..	Ballsbridge, ..	20th May, ..	Do., ..
	1-10-1906 to 30-7-1907	Liffey, ...	Quays and Island Bridge.	About 1st May, ..	Black, ..
		Bray, ...	Bray, ...	1st April, ..	Do., ..
		Dodder, ...	Irishtown to Ballsbridge.	About 1st May, ..	Do., ..
Wexford. ..	1905-1906	Slaney, ...	Wexford, ..	10th and 20th July,	Greyish white.
		Do., ...	Killurin, ..	Do., ...	Do., ..
		Do., ...	Mackmine, ..	Do., ...	Do., ..
	1906-1907	Slaney, ...	Wexford, ..	10th and 20th July,	Greyish white.
		Do., ...	Killurin, ..	25th July, ..	Do., ..
		Do., ...	Mackmine, ..	15th August, ..	Do., ..
		Do., ...	Enniscorthy, ..	Do., ...	Do., ..
Waterford, ..	1905-1906	Barrow, ...	St. Mullin's, ..	12th March, ..	White, ..
		Nore, ...	Woodstock, ..	Do., ...	Do., ..
		Suir, ...	Up to Carrick, ..	About March, ..	Do., ..
	1906-1907	—	—	—	—
Lismore, ..	1905-1906	Blackwater, ..	Cappoquin, ..	12th April, ..	White, ..
		Finisk, ...	Cappagh, ..	Do., ...	Do., ..
		Lickey, ...	Clashmore, ..	Do., ...	Do., ..
	1906-1907	Blackwater, ..	Cappoquin, ..	1st April, ..	White, ..
		Bride, ...	Janeville Quay, ..	3rd April, ..	Do., ..
Cork, ..	1905-1906	Lee, ...	Blackrock Castle,	Middle of March, ..	Black, ..
		Do., ...	Horsehead, ..	Do., ...	Do., ..
		Do., ...	Tivoli, ...	Do., ...	Do., ..
	1906-1907	Lee, ...	Blackrock Castle, ..	About 15th March,	Black, ..
		Do., ...	Cork, ...	1st February, ..	White, ..

RELATIVE TO EEL FRY.

2. When were Fry last seen at the places mentioned in your reply to query No. 1? Were the Fry white or black?		3. When were Fry first seen in the fresh water parts of the rivers and in the tributaries in your District? If possible give the dates of observation at several places on each river.				4. When were Fry last seen at the places mentioned in your reply to query No. 3?	DISTRICT.
Date.	Colour (white or black).	River.	Place.	Date.	Colour (white or black).	Date.	
20th August,	Black,	Liffey, ..	Chapelizod,	5th May,	Black,	30th August,	Dublin.
10th June, ..	Do.,	Bray, ..	Bray, ..	1st May,	Do.,	1st September,	
20th August,	Do.,	Dodder, ..	Ballsbridge,	20th May,	Do.,	8th August,	
30th June, ..	Black,	Liffey, ..	Chapelizod,	8th May,	Black,	—	
1st May, ..	Do.,	Do., ..	Lucan, ..	14th May,	Do.,	29th June, ..	
30th June, ..	Do.,	Bray, ..	Bray, ..	1st May,	Do.,	10th July, ..	
		Wicklow, ..	Wicklow, ..	1st May,	Do.,	—	
		Dodder, ..	Ballsbridge,	10th May,	Do.,	—	
10th and 20th July.	Greyish white.	Slaney, ..	Aghade, ..	1st May,	Black and white.	30th August,	Wexford.
Do., ..	Do.,	Do., ..	Enniscorthy,	Do.,	Do.,	15th August,	
Do., ..	Do.,	Deering, ..	Rathglass,	Do.,	Do.,	30th August,	
		Do., ..	Knocklow,	Do.,	Do.,	16th August,	
		Do., ..	Brone, ..	Do.,	Do.,	21st August,	
		Boro, ..	Kilcarberey,	Do.,	Do.,	15th August,	
15th September,	Greyish white.	Slaney, ..	Aghade, ..	3rd May,	Black and white.	30th August,	
10th October,	Do.,	Do., ..	Tullow, ..	10th May,	Do.,	Do., ..	
Do., ..	Do.,	Do., ..	Rathvilly, ..	1st May,	Do.,	Do., ..	
Do., ..	Do.,	Do., ..	Enniscorthy,	Do.,	Do.,	Do., ..	
May to July, ..	White,	Barrow, ..	Lower reaches,	End or March and early April.	Becoming black as they ascend.	July and Aug.,	Waterford.
Do., ..	Do.,	Nore, ..	Do., ..	Do.,	Do.,	Do., ..	
Do., ..	Do.,	Suir, ..	Upper reaches,	April and May.	Black,	Do., ..	
—	—	—	—	—	—	—	
16th May, ..	White,	Blackwater,	Clondulane,	22nd April,	Black,	15th June,	Lismore.
Do., ..	Do.,	Do., ..	Fermoy, ..	Do.,	Do.,	Do., ..	
Do., ..	Do.,	—	—	—	—	—	
25th April, ..	Black.	Blackwater,	Clondulane,	6th May,	Black,	1st June, ..	
30th April, ..	Do.,	Bride, ..	Conna, ..	13th May,	Do.,	Do., ..	
		Do., ..	Castlelyons,	Do.,	Do.,	Do., ..	
Middle of August.	Black,	—	—	—	—	—	Cork.
		Sullane, ..	Rahilly's Br.,	Middle of April.	Black,	Middle of Aug.,	
		Do., ..	Macroom, ..	Do.,	Do.,	Do., ..	
—	—	Sullane, ..	Rahilly's Br. and Macroom	Middle of April.	—	—	
June, ..	Black,	—					

DISTRICT.	SEASON.	1. When were Eel Fry first seen in the tidal parts of the rivers in your district? Give names of rivers and dates separately, and names of places where Fry were first seen, and, if possible, note whether the Fry were white (*i.e.*, colourless) or black. River.	Place.	Date.	Colour (white or black).
Bantry, ..	1905–1906	All rivers, ..	—	About July and Aug.,	Black, ..
	1906–1907	All rivers, ..	—	June and July, ..	Black, ..
Waterville, ..	1906–1907	Cahirciveen, ..	Westwood, Faughal, Ballycorbry, and Cahirciveen.	23rd and 25th February.	Both white and black.
		Chapeltown Stream, Valencia Island.	At mouth, ..	30th November, ..	White, ..
		Reenglas Beach, Valencia Island.	—	10th March, ..	Do., ..
		Waterville ..	—	4th February, ..	Do., ..
Killarney, ..	1905–1906	Laune, ...	Killorglin, ..	1st February, ..	White, ..
		Caragh, ...	Caragh Bridge, ..	1st to 15th February,	Do., ..
	1906–1907	Laune, ...	Killorglin, ..	1st February, ..	White, ..
		Caragh, ...	Caragh Bridge, ..	1st to 15th February,	Do., ..
Limerick, ..	1905–1906	Shannon, ..	Limerick, ..	February ..	White, ..
	1906–1907	Shannon, ..	Limerick, ..	January, ..	White, ..
Galway. ..	1905–1906	Corrib, ...	Claddagh, ..	24th December, ..	White, ..
	1906–1907	Corrib, ...	Bank Netting Station	14th November, ..	White, ..
		Do., ...	Tower, ...	28th March, ..	White and black
Ballynakill, ..	1906–1907	Erriff, ...	Aasleagh, ..	28th March, ..	White, ..
		Do., ...	Do., ...	10th April, ..	Darker, ..
		Do., ...	Do., ...	13th May, ..	Black, ..
		—	—	—	—
Bangor, ..	1905–1906	Owenmore, ..	Pullahodde, ..	24th April, ..	White and black
		Owenduff, ..	Blackpool, ..	Do., ...	Do., ..
		Newport, ..	—	Middle of April, ..	Black, ..
	1906–1907	Newport, ..	Mill-race, ..	15th April, ..	Black, ..
		Burrishoole, ..	Bridge, ...	20th April, ..	Do., ..
Ballina, ..	1905–1906	Moy, ...	Quay, ...	April, ...	Black, ..
	1906–1907	Moy, ...	Quay, ...	20th January, ..	White, ..
		Do., ...	Salmon weir, ..	End of February, ..	Do., ..

RELATIVE TO EEL FRY—*continued.*

2. When were Fry last seen at the places mentioned in your reply to query No. 1? Were the Fry white or black?		3. When were Fry first seen in the fresh water parts of the rivers and in the tributaries in your District? If possible give the dates of observation at several places on each river.				4. When were Fry last seen at the places mentioned in your reply to query No. 3?	District.
Date.	Colour (white or black).	River.	Place.	Date.	Colour (white or black).	Date.	
About end of August.	Black,	All rivers,	—	August,	Black,	End of August.	Bantry.
August, ..	Do.,	Do., ..	—	July,	—	August, ..	
3rd and 6th December.	White,	—	—	—	—	—	Waterville.
—	—	—	—	—	—	—	
4th March, ..	White,	—	—	—	—	—	
30th April, ..	White,	Laune, ..	Meanus, above Killorglin.	8th Feb.,	White,	7th May, ..	Killarney.
1st to 15th April,	Do.,	Caragh, ..	Above Caragh Bridge.	About 20th Feb.	Do.,	End of May,	
1st May, ..	White,	Laune, ..	Meanus, above Killorglin.	8th Feb.,	White,	10th May, ..	
1st to 15th April,	Do.,	Caragh, ..	Caragh Bridge,	Middle of Feb.	Do.,	End of May,	
February to May,	Black,	Shannon, ..	Castleconnell,	Late in May.	Black,	End of August,	Limerick.
July, ..	—	Shannon, ..	Castleconnell,	July,	Black,	End of August,	
2nd July, ..	Black,	Corrib, ..	Above regulating weir.	About 15th May.	Black,	July, ..	Galway.
30th June, ..	Black,	Oughterard,	Oughterard,	15th April,	Black,	15th May,	
Do., ..	Do.,	—	—	—	—	—	
29th March. ..	Whiteish,	Erriff, ..	Aasleagh, ..	28th Mar.,	Whiteish,	3rd June, ..	Ballynakill.
12th April, ..	Darker,	Do., ..	Do., ..	11th April,	Darker,	—	
21st May, ..	Black,	Do., ..	Do., ..	13th May,	Black,	—	
—	—	Small brooks,	About Aasleagh.	17th May,	Black,	3rd June, ..	
—	—	Owenmore,	Bangor Br.,	5th May,	White and black.	—	Bangor.
—	—	Munhin, ..	Munhin Bridge	6th May,	Do.,	—	
—	—	Owenduff,	Shranamough	7th May,	Do.,	—	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
—	—	Moy, ..	Above Salmon Weir.	April,	Black,	31st July, ..	Ballina.
—	—	—	—	—	—	—	
First week of April.	White,	—	—	—	—	—	

District.	Season.	1. When were Eel Fry first seen in the tidal parts of the rivers in your district? Give names of rivers and dates separately, and names of places where Fry were first seen, and, if possible, note whether the Fry were white (*i.e.*, colourless) or black. River.	Place.	Date.	Colour (white or black)
Sligo, ..	1905–1906	Garvogue, ..	Victoria Bridge, Sligo,	April, ...	White and black
	1906–1907	Garvogue, ..	Sligo, ...	April, ...	White and black
Ballyshannon, ..	1905–1906	Erne, ...	Below Ballyshannon Falls.	28th November, ..	White, ..
		Drowes, ...	At mouth, ..	May, ..	Black, ..
	1906–1907	Erne, ...	Below falls, ..	29th November, ..	White, ..
Letterkenny. ..	1905–1906	Lennon, ...	Ramelton, ..	21st May, ..	Black, ..
		Crana, ...	Milldam, ..	1st May, ...	Do., ..
		Do., ...	Castlebridge, ..	Do., ...	Do., ..
		Gweebarra, ..	Doochary Bridge, ..	Do., ...	Do., ..
		Owenea, ..	Near box net, ..	7th February, ..	Do., ..
	1906–1907	Lennon, ..	Ramelton, ..	1st May, ..	Black, ..
		Crana, ...	Near bridge, ..	15th April, ..	Do., ..
		Gweebarra, ..	Doochary Bridge,	30th March, ..	Do., ..
		Gweedore, ..	Near fishing ground,	15th May, ..	Do., ..
		Owenea, ..	In channels, ..	1st June, ..	Do., ..
Coleraine, ..	1905–1906	Bann, ...	Barmouth, ..	20th March, ..	White, ..
		Do., ...	Castleroe, ..	22nd April, ..	Do., ..
	1906–1907	Bann, ...	Barmouth, ..	22nd March, ..	White, ..
		Do., ...	Castleroe, ..	23rd March, ..	Do., ..
Dundalk, ..	1906–1907	Dee, ...	Willestown Weir,	10th June, ..	Black, ..
		Glyde, ...	Lyons Weir, ..	Do., ...	Do., ..
		Fane, ...	Blackrock, ..	15th June, ..	Do., ..
		Castletown, ..	Railway Bridge, ..	Do., ...	Do., ..
		Shimna, ..	South of Castle Bridge	Do., ...	Do., ..
Drogheda, ..	1905–1906	—	—	—	—
	1906–1907	—	—	—	—

RELATIVE TO EEL FRY—*continued.*

2. When were Fry last seen at the places mentioned in your reply to query No. 1? Were the Fry white or black?		3. When were Fry first seen in the fresh water parts of the rivers and in the tributaries in your District? If possible give the dates of observation at several places on each river.				4. When were Fry last seen at the places mentioned in your reply to query No. 3?	DISTRICT.
Date.	Colour (white or black).	River.	Place.	Date.	Colour (white or black).	Date.	
End of May, ..	White and black.	Garvogue, ..	Victoria Bridge Salmon ladder.	End of May.	White and black.	End of May,	Sligo.
—	—	Unshin, ..	Avena Mills, Ballysodare.	About 7th April.	Mostly black.		
July, ..	Black.	Garvogue, ..	Victoria Bridge Salmon ladder.	—	—	20th July,	
End of May, ..	Black,	Erne, ..	Above falls,	18th April,	—	End of June,	Ballyshannon.
June, ..	Do.,	Drowes, ..	Above bridge,	June,	—	Do., ..	
End of May, ..	Black,	—	—	—	—	—	
31st May, ..	Black,	—	—	—	—	—	Letterkenny.
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
1st June, ..	Black,	—	—	—	—	—	
—	—	Owenea, ..	—	1st Feb.,	—	—	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
24th May, ..	White,	Bann, ..	Carnroe, ..	8th May,	Black,	1st May, ..	Coleraine.
21st June, ..	Do.,	Do., ..	Loughbeg, ..	20th June,	Do.,	15th August.	
26th May, ..	White,	Bann, ..	Carnroe, ..	6th May,	Black,	8th June, ..	
20th June, ..	Do.,	Do., ..	Loughbeg, ..	18th June,	Do.,	30th June,	
31st July, ..	Black,	Dee, ..	Whitemills,	10th Aug.,	Black,	1st September,	Dundalk,
Do., ..	Do.,	Glyde, ..	Maplestown Bridge.	15th Aug.,	Do.,	Do., ..	
15th August,	Do.,	Fane, ..	Channonrock,	Do.,	Do.,	10th September	
Do., ..	Do.,	Castletown,	Philipstown Mill.	Do.,	Do.,	Do., ..	
Do., ..	Do.,	Shimna, ..	North of Castle Bridge.	Do.,	Do.,	Do., ..	
—	—	Boyne and tributaries.	—	May and June.	—	—	Drogheda.
—	—	Do., ..	—	Do.,	—	—	

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NOTE.—The references expressed in Roman numerals are to the separate numbers of "Scientific Investigations, 1906," to which the divisions of this appendix correspond. The Arabic numerals which follow refer to the pagination of each number.

The Arabic numerals in square brackets refer to the continuous pagination of the appendix, at foot of each page.

D.

E.

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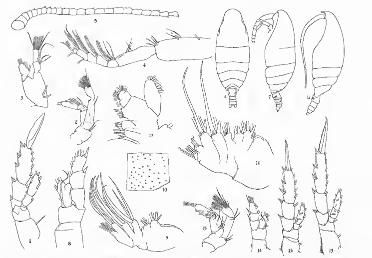
(20047). Wt. 27737. 11. 1908. 1000.- A. T. & Co. (Ltd.).



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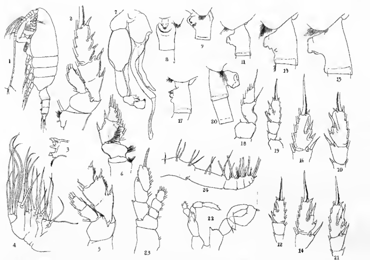

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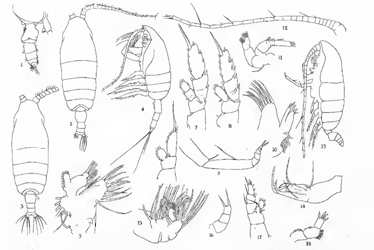

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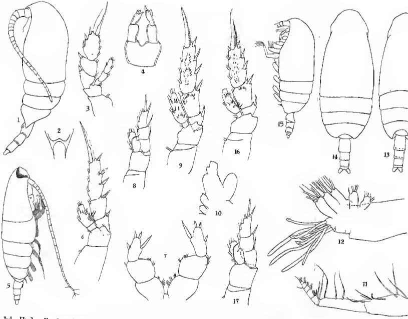

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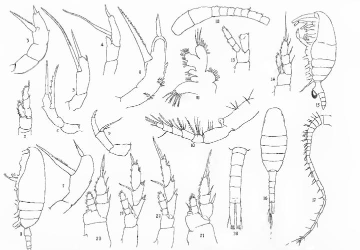

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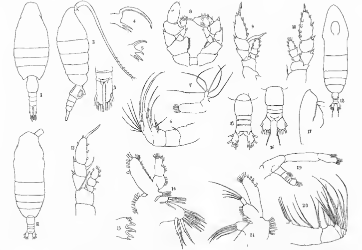

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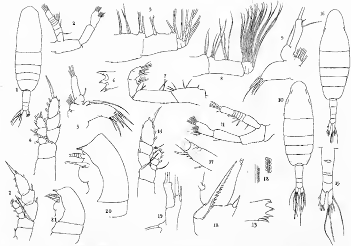

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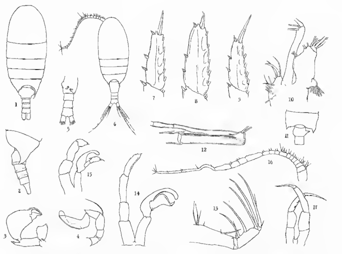

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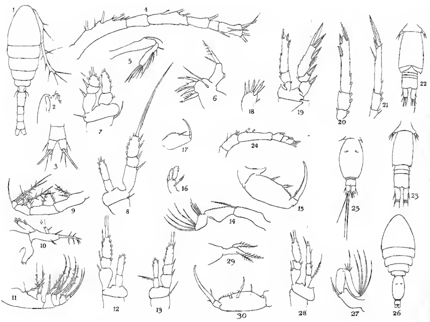

1-13. Paroithona parvula. 14-24, Oncaea obscura. 25-30, Oncaea exigua.

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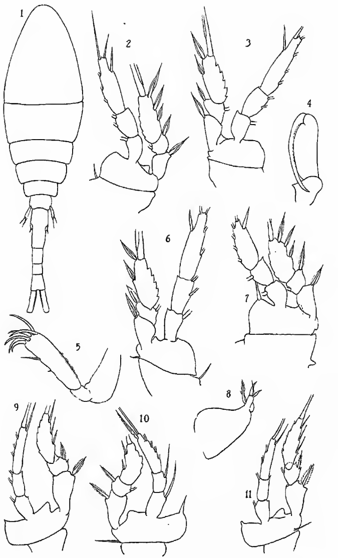

1-8. Lubbockia brevis. 9-11. Oncaea exigua.

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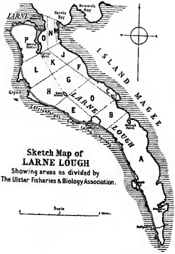
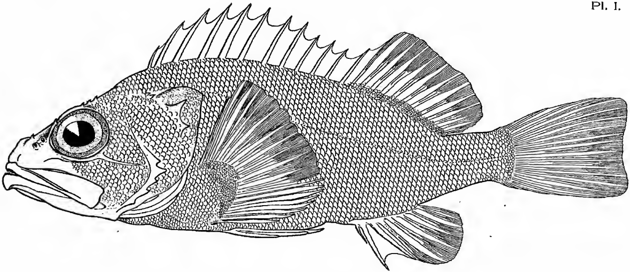


Sketch Map of
LARNE LOUGH
Showing areas as divided by
The Ulster Fisheries & Biology Association.



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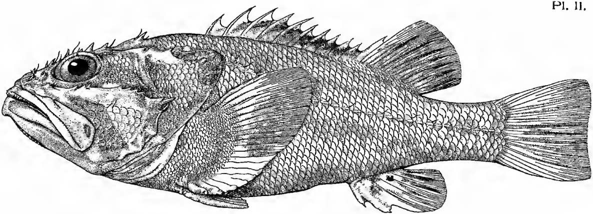
Scorpaena dactyloptera.



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Scorpaena cristulata.

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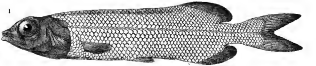

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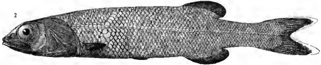

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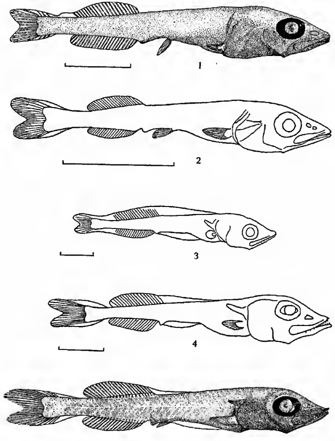
1. Alepocephalus rostratus.
2. Alepocephalus Giardi.



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I, 2, Alepocephalus Giardi.
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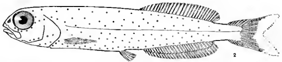

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2. L. W. B. } del.

1. Alepocephalus macropterus.
2. Xenodermichthys socialis.